VOLUME 65 • JANUARY 1957 • NUMBER 1

A.M.A. ARCHIVES OF

# OTOLARYNGOLOGY

Changing Aspects of Otolaryngology
*Frederick T. Hill*

Male and Female Voices
*William A. C. Zerffi*

The pH Factor in Treatment of Otitis Externa
*Noah D. Fabricant*

Potentiated Anesthesia Derived from Artificial Hibernation
*Pedro Hernandez Gonzalo*

Management of Fractures and Soft-Tissue Injuries About the Face
*John B. Erich*

Cogan's Syndrome
*Greydon G. Boyd*

Objective Audiometry
*H. G. Kobrak*

Clinical Determination of Abnormal Auditory Adaptation
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An Unusual Complication of Otitis Media
*Fred Harbert and Henry H. Sherk*

The Paranasal Sinuses
*Samuel Salinger*

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# A. M. A.
# ARCHIVES OF OTOLARYNGOLOGY

Continuing the Publication
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VOLUME 65 JANUARY 1957 NUMBER 1



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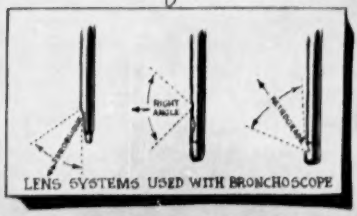


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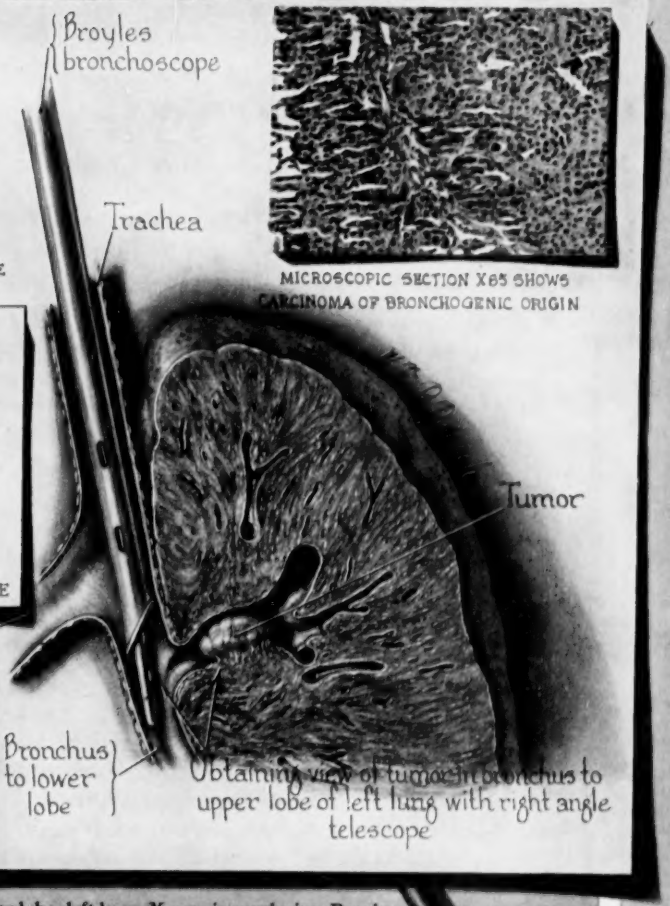
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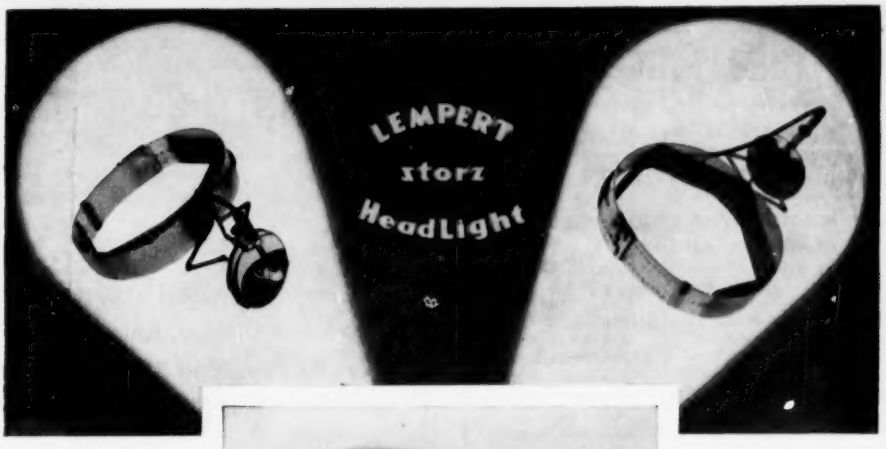
With this issue, the A. M. A. ARCHIVES OF OTOLARYNGOLOGY presents a new cover design and a slight modification of page format.

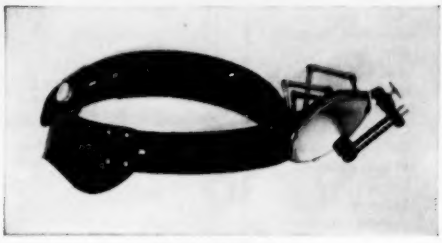
Two elements contribute to an attractive cover—simplicity and cleanliness. We believe that we have obtained the two primary objectives necessary in a cover design of this nature: namely, that it is attractive and that it conveys the subjective feeling of the unit which it represents, as well as legibility, which is important in this case because of the contents listing involved. This cover is fluid enough to attractively accommodate varying lengths of contents listing. By the use of a simple line or block treatment, and by placing the contents upon a white background, we gain the maximum contrast possible, therefore, greater legibility.

The use of the seal has several functions: Being a circle in design, it relieves to an extent the over-all use of lines, squares, and rectangles; it stands as a symbol for the many years of dedicated service by an organization of the American Medical Association's stature in the advancement of knowledge in specialized fields, thus adding immeasurably to the effectiveness of the design.

The change in page format is confined to the title, subtitle, and authors' names. The change from a Coronet Bold type face to Bodoni Bold will eliminate the difficulty encountered when reading a formula or an abbreviation in script capitals. The use of Antique Italic for subtitles and Spartan Bold for the authors creates a desirable distinction between these parts. The arrangement realizes a saving in space.

This new cover is a development of an idea. It is not the result of a sudden thought. First, a suggestion was presented which was nothing more than a different arrangement of familiar elements. Then followed the collection of reactions, suggestions, and additional experimentation in search for the inspiration. All of the separate bits of information gathered were thoroughly digested, and the relationship between elements was established. The result is the crystallization of the idea. In following this procedure, our readers and editors have contributed immeasurably to the end product. Their cooperation means a new design of lasting quality.





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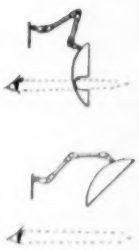

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A.M.A. ARCHIVES OF
OTOLARYNGOLOGY

# Changing Aspects of Otolaryngology

FREDERICK T. HILL, M.D., D.Sc., Waterville, Maine

The changing aspects of otolaryngology seems to be a favorite subject of almost every one over the age of 60, which age my old chief, Dr. Mosher, used to say was "when one reached maturity, if ever." Many of these addresses have been largely defensive, bravely asserting that ours is not a dying specialty, as if there had been any valid evidence of degenerative changes; or perhaps hoping to attract younger man who might see a future in our field.

It is not my purpose to defend or even to crusade, for our specialty needs no defense. Nor does it need crusading. Indeed, it is a healthy, vigorous specialty with a future which is challenging, a specialty which demands the best of minds and skills as never before. All I hope to do is to discuss some of the changes brought about by the tremendous scientific developments of the past few years and which, despite the carpings of some, have succeeded only in making otolaryngology a broader specialty, with greater opportunities and newer responsibilities. No longer can we consider mere technical proficiency in the performance of mastoidectomy, tonsillectomy, submucous resection, or sinus surgery the criterion for evaluating an otolaryngologist. With the continued developments of science, especially in biochemistry and physics, medicine possesses diagnostic and therapeutic procedures which would have been beyond comprehension a few years ago. And just as these have broadened our own particular specialty, so at the same time they have emphasized the interdependence of all fields of practice. Enzymes, steroids, hormones, and isotopes all create a medicine which permits no isolationism.

To meet this responsibility, this challenge, the otolaryngologist must have a broader concept of the field and of the individual patient. He must be concerned with preventive, habilitative, and rehabilitative measures, as well as with curative procedures. He must be broader than his specialty, ever alert to the particular skills in allied medical and nonmedical fields which would benefit the patient and speed his recovery. We must think in terms of complete patient-care.

Indeed, the field of otolaryngology itself has become so broad that rarely do we find a person capable of mastering it in its entirety. If attempted, there is apt to be considerable variation in the quality of the work. It would require something of a prodigy to acquire all the techniques of otolaryngological surgery and bronchoesophagology, including fenestration, stapes mobilization, maxillofacial plastic surgery, neck surgery, and neoplastic surgery of the entire field, and to continue equally proficient in all, throughout one's career. To obtain a thorough understanding of audiology, of acoustics, of the electropotentials of the cochlea, the dynamics of the labyrinth, of

Accepted for publication Aug. 15, 1956.

From Thayer Hospital.

Address of Guest of Honor, Canadian Otolaryngological Society, Quebec, Canada, June 6, 1956.

the problem of habilitation and rehabilitation of the deafened, of speech defects, in addition to a comprehensive knowledge of clinical otolaryngology, would require a background not generally available in the average good residency. Yet all these are within our province.

To cope adequately with the problems of deafness frequently calls for the cooperation of those experts both in allied medical and nonmedical areas. We may search our own field for evidence of excessive lymphoid tissue, infections, or altered nasal air currents to the exclusion of other possibly significant conditions better handled by the internist, the endocrinologist, the pediatrist, or the psychiatrist.

In dealing with Ménière's disease, except in the rare case in which labyrinthotomy may be justified, I feel there may be distinct advantages in working in close conjunction with an internist skilled in the management of vascular conditions. The fundamental imbalance of the autonomic nervous system, the importance of the stress factor, and the probability of a functional overlay make therapy carried out solely by the otologist often inadequate. I cannot view this condition as isolated within the vascular bed of the internal ear. The clinical manifestation may seem to be so localized, but an over-all approach to the problem would seem preferable.

Few of us profess to any but the most superficial knowledge of acoustics. We may diagnose the particular type of hearing defect and suggest the indicated therapy: preventive at times, surgical on occasion, rehabilitative frequently. But often we need the help of the audiologist, skilled in determining that noise level which might be a factor in industrial deafness, or in providing just the proper type of amplification; the aid of the special educator, the teacher of speechreading, to habilitate or rehabilitate the deafened child.

For years we took little interest in providing amplification for deafened patients who might be benefitted by the use of hearing aids. These were left almost exclusively in the hands of dealers. We are all aware of the widespread solicitation of potential purchasers and the high-pressure salesmanship often exercised to sell or replace hearing aids. It should be our responsibility to advise and guide these deafened people, to protect them from exploitation. The ideal remedy would seem to be in the further development of hearing-aid centers, which can be set up in any hospital having a department of otology.

The hospital also can be used to establish classes in speechreading, as has been so well demonstrated by Dr. Wishart's Clinic in Toronto, Canada. Teachers of the deaf are none too plentiful, but more are being trained each year. The dividends in habilitated children who, at last, are able to take their places in society are exceedingly gratifying. We have seen our class in speechreading, at the Thayer Hospital, grow in eight years in number of children, from 3 to 85.

If I have seemed to limit my examples to the field of otology, it is only to conserve time. Many others come readily to mind, such as the increasing use of the tumor board, the isotope laboratory, and the geriatric clinic, as well as physical and occupational therapy.

Generally the otolaryngologist is the person first consulted in cases of stammering or other speech disorders and is in the strategic position to advise the corrective teaching of the speech therapist. And we should know that this person has much to offer, if we are to rehabilitate satisfactorily the patient who has undergone laryngectomy, or repair of hare lip or cleft palate.

I am sure we all encounter many patients with a referred or self-made diagnosis of sinusitis which cannot be substantiated. A large percentage of these prove to be cases of frank allergy. It is disturbing to note how frequently these have been treated by repeated surgical procedures and with complete disregard of the basic cause. A careful, well-taken history, which after all is the most important part of any examination, plus routine cytological studies, would

avoid much unnecessary surgery. While we should recognize allergic manifestations in our field, I feel the solution of the problem and the therapy is best managed in cooperation with the allergist.

All this implies a sharing of work among one's confreres, an informal division of labor, based upon particular interests and skills. It does not mean rigid limitations, a closed shop, but a recognition that certain procedures or problems require certain special technical skills or knowledge, and that when these skills are available, use should be made of them. It may require honesty, courage, and altruism, but the results make it both laudable and, in the end, rewarding. For, as one of my old teachers, Dr. Eugene Crockett, once said, "Your best work is judged by your poorest."

This demands something different from what we might term the "solo practice" of earlier days. None of us has the ability to master all the knowledge available in our own and allied fields, knowledge which may have important bearings in the solution of the problems we face. This philosophy of practice necessitates an increasing use of the consultation and the joint management of therapy, based upon the individual skills that may be available, not only within our own specialty but with the internist, the pediatrist, the neurologist, and the psychiatrist, whoever may contribute to the benefit of the patient. It includes an increasing use of nonmedical workers in the fields of audiology, microbiology, physics, biochemistry, and special education, and in physical and occupational therapy.

This means what might be considered, at least in the intellectual sense, as group practice. And this, for reasons of efficiency, convenience, and economy, will lead, in all probability, toward a greater use of the hospital, with physicians' offices located either in or adjacent to it. As you know, this arrangement is an accomplished fact in many communities and is most satisfactory from the point of view of the physician, the patient, and the hospital. It makes sense.

This leads me to a few observations about the hospital and our relations to it. That I may qualify myself in this regard let me say that while my clinical practice has been confined to otolaryngology, some 25 years ago certain events forced me into the hospital field as the medical director of a group-practice type of institution. This has proved exceedingly interesting and instructive. It has given me a better insight into the administration of the hospital and a broader understanding of the problems of patient care, and for which I am most grateful.

The interne or resident today leaves the hospital at the end of his allotted stay with an adequate training in clinical medicine, but with little or no comprehension of the many factors involved in its operation. Some indoctrination into the objectives, and the philosophy, and the problems of the hospital could do much to dispel the misunderstandings, and even the antagonisms, which can be so detrimental to hospital, staff, and patients. If the young doctor is fortunate, his particular hospital may have had a well coordinated staff, with an administration concerned with the quality of patient-care, with encouraging consultations, with a good educational program. If he is especially fortunate he may have been in a hospital in which the staff and the nursing service might have been collectively interested and cooperating in a program designed to improve patient-care. Too often all such efforts are either sporadic, or confined to some segment of the hospital, or are nonexistent.

As attending physicians we will insist that our orders for patients be carried out, that our laboratory tests and x-rays are accurate, and that our operating-room facilities are efficient. But have we concerned ourselves with the many other things which can make such differences to our patients: peace of mind, relief from worry, understanding of a strange environment, of unexpected procedures, and what we might call "creature comforts"?

Two years ago, at the request of *The Modern Hospital*, the Institute for Motiva-

tional Research conducted a psychological study of hospital-patient relationship, which has proved most revealing. With the use of purely psychological techniques, this was done on a qualitative rather than a statistical basis. A number of hospitals, ranging in size from 70 to 400 beds, and located in different types of communities, were used in the study.

The method of study included content analysis of hospital literature, magazine and newspaper articles, followed by insight (clue) interviews, observations within the hospitals, depth interviews (nondirect probing such as employed by the psychoanalyst), and projection tests. Patients, former patients, citizens of the communities, and members of the hospital staffs (administrative, medical, and nursing) were included in this study. The material resulting from this was so consistently uniform that very definite conclusions could be drawn, conclusions which should be significant to us as physicians.

Most of us, I am sure, tend to evaluate a hospital on the basis of completeness and efficiency; adequacy of equipment, facilities, and beds, and the quality of the professional services, on the floors, in the operating suite, and in the laboratories. And we may add something if the buildings are imposing and the interiors attractive. This study indicates that, while attractive environment and efficient professional services and facilities mean much to the patient, there is a prime nonmedical factor which rarely is given due consideration and which has a tremendous effect upon his hospital experience, and which even influences his speed of recovery. It shows that the ideal hospital, to the patient, is one with a warm, friendly, understanding environment, and that buildings and equipment are secondary in importance.

One of the most striking facts brought out in this psychological study was that the adult patient on entering a hospital becomes emotionally a child. There is a prime feeling of fear, and of insecurity. This is not only the fear of impending surgery or repair, but there is a dread of making necessary adjustments to a strange environment, to unknown and uncomfortable procedures. He resents, perhaps unconsciously, being "helpless as a child," dependent upon someone else, of having no control over his environment. He may be frightened by rumors or gossip and often reads all sorts of meanings into what is seen or heard. He resents certain procedures which cause physical embarrassment, such as those related to disrobing, the toilet, or bedpan. There is a threat to his individuality, his maturity, his adulthood, and his illness is seen subconsciously as a failure, or sign of aging, or of deterioration. While there is no such thing as "too much care," it is the quality rather than the amount of care with which he is concerned. It is the attitudes rather than the procedures themselves to which he reacts.

Unconsciously he says, "Care for me but also respect me." He requires assurance, explanations, information regarding this strange environment over which he has no control. There must be no surprises. He needs reassuring information regarding different procedures, the usual postoperative period of depression, matters of physical embarrassment.

In this period of emotional regression to child-like helplessness the hospital assumes something of the character of the home and the family, and he senses attitudes in the entire organization as he would in the family. For example, an unanswered bell may make him feel rejected like an orphan thrust into an unsympathetic foster home. Most minor complaints, such as those related to lukewarm coffee, food seasoning, and the temperature of the room, actually result from emotional insecurity.

Boredom and frustration may be symbolic of a feeling of neglect or abandonment and may lead to emotional panic, which could be avoided by better use of play or recreational activities. Rarely has full use been made of occupational therapy. Too often this is employed in purely a rehabilitative sense as a form of physiotherapy. Yet it can be of

immeasurable value to the average patient, even on the otolaryngological service, to combat the deadly inactivity often imposed upon a patient. There may be a feeling of loneliness which is not relieved by the usual well-meaning but often tiring visits of relatives and friends. He would like to talk with someone in the hospital family—doctors, nurses, and other patients. Particularly in the convalescent period there is considerable value in group activities, hospital bulletins, and house organs. As a result we will see an increasing use of the newest member of our hospital personnel, the recreational director.

Interestingly enough, the doctor symbolically becomes the father often far beyond what the actual situation entails, strong, capable, dominant, all-powerful, while the nurse takes over the reassuring sympathetic qualities of an idealized mother.

It was found that the type of administration, the atmosphere of the hospital, and the attitudes of the medical and nursing staffs had a marked influence upon patients. Hence conflicts between departments and persons in this hospital organization, whether between doctor and nurse, doctor and administrator, doctor and doctor, added to the feeling of insecurity. These were sensed quickly throughout the institution. It is similar to the family. When there is no respect within the family the child loses respect for either the father or the mother. Certain institutions were administered most efficiently but in a cold, authoritative manner with endless rules and regulations, which "was like being in a factory" or "like policeman doing his duty without feeling." This type definitely was productive of conflict and insecurity! The laissez-faire type of hospital, on the other hand, had no conflicts and no rules or organization. While interrelations were friendly, the patients nonetheless had a marked sense of insecurity. In contrast to these was the disciplined but permissive type, where there was basic security evoked by rules which had rational validity. The patient here realized that the routine was carried out with concern and consideration as in a "loving family." This type, the secure hospital, had both rules and relaxation of rules, giving a real sense of comfort and security.

This may not seem germane to my subject. It certainly is not a particular problem of otolaryngology. But it does concern us as physicians, practicing a specialty which accounts for a large percentage of total hospitalizations. As regards our patients, we are "our brother's keepers." As members of an old and respected specialty we should be concerned with the hospital and the quality of patient-care. Just as we insist upon the best of medical service for our patients, we should exert our influence to see to it that these nonmedical factors be given full consideration. We should strive by example and by precept to make our hospital a secure one rather than the conflict type. Individually we can do much by providing our own patients with that reassurance, and that understanding, that can mean so much to them.

It implies incorporating something of the teaching of that First Great Physician in the practice of the modern specialist, thawing the cold efficiency of science with the warmth of human understanding and sympathy.

Dr. Arthur S. Adams, President of the American Council on Education, has used the analogy of the hand to convey the importance of coordinating factors. He said the hand could be waved, grasped, folded, or put to the plow but that it required complete and perfect articulation of the thumb and fingers to function efficiently. Let us think of these five digits as representing knowledge, skill, industry, understanding, and sympathy. Used together in complete articulation, like the hand, these may be devoted to a common constructive purpose, that of providing the best and most complete type of patient-care.

Two years ago in an address before the American Otological Society I took as a text one of the wise aphorisms of my old and beloved chief, Dr. Harris P. Mosher: "The strength of specialism is specialism

and, paradoxically, the weakness of specialism is specialism." In closing I said at that time, "The strength of specialism is knowing more about a limited field. Its weakness is that this knowledge is restricted to a limited field. If we recognize such limitation and utilize the available skills in other fields, we overcome our weaknesses and increase our strength." We have seen tremendous advances in the practice of medicine. Otolaryngology has broadened its field, has so expanded its horizons that some sort of division of labor, based upon special skills or interests, is inevitable. We must be concerned with preventive, habilitative, and rehabilitative measures, as well as curative medicine. This calls for team work which utilizes all indicated skills in both our own and in allied professional areas. It calls for the best of over-all patient-care, taking a vital interest in and cooperating with our hospitals to this end. The future of otolaryngology is indeed bright but presents a stern challenge which we must meet with honesty, integrity, industry, and courage.

In the words of Dr. J. L. Rosenstein, "Progress is not made by taking pride in our present standards but by critically examining these standards, hypothetically setting higher standards, and attempting to achieve them."

11 Dalton St.

# Male and Female Voices

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It is an interesting fact that the only difference between the male and female larynx is one of size, and, further, that within each voice category marked differences in size are to be observed. The cords of a soprano are shorter than those of a contralto, and the cords of a tenor are shorter than those of a bass. In this they follow the parallel of instruments such as the violin, viola, cello, and bass fiddle. The larger the instrument and the longer the string, the lower the tone which can be produced. Conversely, the shorter the string the higher the tone the instrument can yield.

Taken at its face value this would appear to be a very simple proposition. All that is necessary would be to examine the larynx and the length of the cords would indicate in which category a singer belongs. Unfortunately, however, the laryngoscope is hardly ever considered to be a part of the voice teacher's equipment; in fact, there are many teachers who frown upon its use, holding that it merely complicates matters and serves no useful purpose. It is therefore usually left to the judgment of the teacher to decide which kind of voice the student possesses. This system fails to take into consideration the fact that we have the ability to imitate sounds of various types with our voices and that bad habits of voice production can so mask the true quality of the voice as to make it difficult, even impossible, to determine the character of the voice until such faulty habits have been eliminated.

To add to the confusion we hear of cases where contraltos have been made into sopranos and baritones into tenors. To the physiologist the suggestion that the length of the vocal cords could be increased or diminished is obviously absurd, but, in spite of this, cases do exist where a singer having sung, let us say, contralto for some years decides to sing soprano, and is often able to carry out such a plan. Since it is impossible to alter the size of the larynx, another explanation must be sought. The normal pitch mechanism of the human voice is capable of producing a wide range of tones, three octaves and often more. It is possible and probable that the so-called contralto in the belief that she was a contralto never even tried to sing higher than some arbitrary limit set by herself or her teacher, and then suddenly decided that she would make use of tones which were there all the time but had never been employed. Now, if this singer has a soprano larynx, well and good, but should she possess a contralto larynx and is obliged to produce the upper tones with muscular drive, the soprano career will be a short one. In such a case the laryngoscope would have prevented this inevitable disaster. Another reasonably accurate, though by no means infallible method of determining the type of voice a singer possesses is to take the build of the singer into consideration. Short people are likely to have higher voices than tall people, but there are exceptions to this rule. Some tall people have relatively small heads and necks, so that the safest method of determining the character of the voice is by means of the laryngoscope.

Thus far we have been considering the possibility of a singer who was trained to sing in a low voice attempting to sing in a higher register, but the reverse sometimes has been attempted. Some sopranos who find that the higher tones are difficult to reach arbitrarily decide, or sometimes have this decision made for them, that they are not sopranos but are either mezzosopranos or even contraltos. It does not seem to be generally known that heavy low tones can

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artificially be achieved by a singer with a soprano larynx by forcing the false cords down on the true cords, which action produces a heavier vibrating mechanism and enables the singer to emit a tone resembling that of a contralto. While it is possible to do this in the lower range of the voice, the attempt to sing even relatively high tones requires that this dual cord production be eliminated. This results in a definite change of quality which is characterized as a "break" in the voice. In fact, this sudden change of quality produces a result somewhat akin to what in men's voices is called falsetto. Such forced low tones are referred to as "chest tones," a misnomer, for no tone-producing mechanism is located in the chest. This incorrect method of voice production is largely responsible for the persistence of the belief that the voice is divided into registers. It cannot be too strongly affirmed that in the correctly produced voice registers do not exist, but they are frequently to be found in voices where the production is faulty. Any observer trained in laryngoscopy will find that the only changes in the action of the vocal cords when a singer is proceeding from low to high tones is that when low tones are being produced the glottis is relatively open, this space gradually diminishing as the cords are tensed and shortened by the adjustments made by the pitch muscles. Nothing which could be classed as a change of register will be observed. While a singer may find it difficult to sing up and down the scale while the laryngoscope is being used, a little practice will eliminate this difficulty, and when this has been accomplished the observer will be in possession of accurate information as to the action of the vocal cords. It has frequently been suggested that the unusual position of the throat necessary in order to make a laryngoscopic observation vitiates the results obtained, but the only major change which takes place is that the tongue is drawn forward, and tones should not be made with the help of the tongue. In view of the fact that the field of voice production is literally flooded with suppositions and even superstitions as to the function of the vocal organ when producing tone, it would seem mandatory that a strenuous attempt be made to obtain the true facts which underly the production of the voice.

So far we have been considering the female voice, and while it presents many difficulties, these will be found to be relatively minor compared with those encountered in the male voice.

As was said earlier, the main difference between the male and female larynx is one of size, that is, the length of the vocal cords. The action of the mechanism when used correctly is identical with that of the female voice. That is to say it should be, but what do we find in actual practice?

Except in the case of light lyric tenors, the male voice is as a rule divided into two so-called registers: those of the chest, or what is mostly called the normal voice, and falsetto. The tone referred to as falsetto has been the bugbear of every male singer since the beginning of singing. The term falsetto originated before any laryngoscopic observations had been made and, as its name implies, was believed to be made by the action of the false cords. Observation of the cords during the production of a "falsetto" tone, however, will prove this belief to be false. This tone is produced by the action of the true cords and therefore to speak of it as a false tone is to talk nonsense. If it is not a false tone, what is it? The answer is that it is the undeveloped tone of the male voice. Since speech requires but a limited degree of pitch, the pitch muscles have received relatively little development. This is usually sufficient to permit medium and low tones to be increased in volume. But the production of the higher tones requires greater strength of the pitch muscles (the cords have to be tensed to a far greater degree), and high tones cannot be sung with any degree of volume until such development has been achieved. Experiments with male voices, particularly those of nonsingers, will show that an average male voice is capable of producing a wide range of pitch when

the voice is used lightly and no attempt is made to increase the volume. But most singers, being unfamiliar with the action of the vocal mechanism, discard this light tone as useless or false. Had they only the knowledge and the patience required to develop and strengthen the pitch muscles they would in time be able to sing high tones with the same or even greater volume than is possible in the lower range.

This principle of voice development, so far as male singers are concerned, is almost never adopted. The training of male voices is based upon the falacy that the voice is divided into two parts: chest, or normal, voice and falsetto. Disregarding the falsetto, it is attempted to produce the upper tones by forcing the so-called chest voice into the higher registers of tone without first developing the pitch muscles. This can be achieved only by bringing the external, or swallowing, muscles into play, causing an action similar to that which occurs when swallowing, namely, forcing the cords together in a sphincter action and then driving the breath between the cords with sufficient force to produce the tones required. Since basses and baritones are not required to sing tones of so high a pitch as tenors, it is in the tenor voice that this type of forced production reaches its full development. When the pitch muscles are correctly and fully developed, force is not necessary to produce high tones, but how seldom is this result ever attained!

Some years ago Ernest Newman, the well-known English music critic, made the following observation about singers. He said: "Not one opera singer in five hundred can sing the notes and sing the character. He can only produce certain tones with his mouth and its internal fittings in certain positions; and in the effort to get these positions he visibly ceases to be Romeo or Siegfried and becomes John Jones or Samuel Brown. Watch him 'covering' one of his high tones for instance, and see how, in the effort, all dramatic expression goes out of his face; he just 'lays' the tone as a hen lays an egg by a purely physical process." When singers are producing tones under the conditions just described it is difficult to see how any other result can be obtained. The extreme physical exertion necessary to sing in this manner would naturally preclude any attempt at dramatic expression. It will be noted that Newman spoke of Romeo and Siegfried, two tenor roles, and did not include female voices in his remarks. There is a very good reason for this, namely, it is physically impossible for women to force their voices to as great a degree as is possible for men to achieve. The following quotation from "The Mechanism of the Larynx" by V. E. Negus supplies proof of the validity of this statement. "By means of the laryngoscope the cords of a man are seen to shut with a snap on making effort with the arms in an adducted position . . . . As the effort becomes greater, so the closure of the glottis is more forcible, and in some cases the ventricular bands [false cords] approach each other and may touch along part of their length . . . . In the case of women, closure of the glottis on arm effort is the exception; women have comparatively little strength in their arms."

It has often been said that there is always a scarcity of tenors, which, under the existing conditions, should not cause surprise. To sing in the tenor range with this forced type of production calls for a larynx capable of enduring tremendous abuse, and it should not be difficult to understand that the majority of men who attempt this feat find it to be an insurmountable task. When discussing the female voice I pointed out that there are cases where contraltos are able to make the transition to the soprano range, and the same is true of baritones. However, here again it often happens that a tenor who had been erroneously classed as a baritone finds himself capable of singing in the tenor range. When this occurs it is often believed that a baritone has been changed into a tenor. This encourages others, sometimes true baritones, to believe that they too can make the transition. Occasionally by the exertion of tremendous effort they succeed in singing tenor roles, but since they

are powerless to change the length of their cords they do not become tenors but are baritones who by sheer physical drive are able to reach the high tones required of tenors. How great the effort necessary to accomplish this result is evidenced by the fact that such singers are often obliged to wear a type of corset or leather support in order to avoid doing serious damage to their abdominal organs. Surely no one can class this exhibition of brute force as artistic singing, but there are many who acclaim it somewhat as they do other feats of physical violence, such as prize fighting or wrestling. Who has not witnessed the spectacle of a tenor with reddened neck and contorted face blasting forth a high C and being rewarded with a salvo of bravos?

Were singers and teachers of singing familiar with the construction of the vocal organ, the cords not even an inch long and a fraction of an inch wide, they would realize that it is little short of criminal to apply such force to so delicate a mechanism. Small wonder that the careers of many seemingly promising singers are relatively short and that when they rely on sheer physical force they are unable to sing with artistry.

Under such conditions it is not surprising that there are so few tenors available. Only the very toughest larynx can possibly withstand such abuse. Basses and baritones are relatively plentiful, not that their method of producing the voice is better than that of tenors, but, not having to strive for such high tones, their vocal organs are not subjected to such severe abuse. But it is a question of degree not of kind. By what might appear to be a paradox, the female voices last longer because their owners are physically incapable of abusing them to as great a degree as is possible for men to achieve.

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# The pH Factor in Treatment of Otitis Externa

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The numerous therapeutic regimens associated with the management of the various types of otitis externa provide clear proof of the ineffectiveness of any single method of treatment. The introduction of a succession of new drugs has repeatedly seemed to solve the problem; yet clinical experience has invariably brought to light shortcomings that often counterbalanced any effectiveness these agents were thought to possess.

Until fairly recently little attention was paid either to the pH of the cutaneous surface of the external auditory canal or to the pH of the solutions applied to it. Elsewhere I[1] have pointed out that these matters should always be considered in treatment of otitis externa. According to McLaurin,[2] it is not uncommon to find that the difference in effectiveness of two apparently similar agents is due to the ability of one medicament to produce or enhance a state of acidity, while the other produces or enhances a state of alkalinity that is unphysiologic and provides fertile soil for the propagation of infection. Once there is interruption of the continuity of the epithelial lining and an alteration of the pH from the acid to the alkaline side, bacteria and fungi have their greatest opportunity for growth and multiplication. These properties are enhanced by the use of solutions in the external auditory canal whose pH is alkaline.

Susceptibility to infection by bacteria is widely held to be due to the removal of the antibacterial "acid mantle" of the skin and its displacement by an abnormal "alkaline mantle." This phenomenon is especially applicable to the external auditory canal. The external auditory canal, by virtue of its exposed position to the outside world, is subject to dermatological lesions, traumatic and clinical indignities, and to invasion by a host of micro-organisms. Here, a moist environment containing cellular detritus and cerumen frequently serves as an adequate culture medium for the growth of bacteria and fungi.

Generally, the seborrheic areas of the body are more alkaline than other parts of the skin's surface. Alkaline areas are less bactericidal than the rest of the skin and consequently are predisposed to infection. There is a shift of the pH of the skin toward the alkaline side in most cases of vesicular eczema. Some dermatoses are associated with excessive dryness of the skin. As the dryness becomes more pronounced, the tendency to fissure formation is increased; in turn, this tendency contributes to an increase in alkalinity. The highest degree of alkalinity is found in fissures present in eczematous processes. In view of these findings, the logical conclusion in managing many skin diseases is therefore not to "alkalinize" but rather to "acidify"—at least as regards the skin's surface.

Measurements of the pH of the cutaneous surface of the external auditory canal in adults with no apparent lesions in the external auditory canal, which I reported in 1949, revealed little difference in the pH of men and women. The pH values fell chiefly within the acid range. In the group of men, the pH range of the skin of the external auditory canal was found to be from 5.0 to 7.8, while in the group of women, the pH range of the skin of the external auditory canal was found to be from 5.0 to 7.6. Of 30 men, 23 evinced pH values within the acid range; of 30 women, 21 evinced pH values within the acid range.

## Present Investigation

In the present investigation, measurement of the pH of the affected cutaneous sur-

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face of the external auditory canal was undertaken in 11 adults (8 men and 3 women) with otitis externa. A specially adapted silver-silver chloride glass electrode, used in conjunction with the Coleman electrometer, was introduced into the affected external auditory canal so as to assure adequate contact with the cutaneous surface of the membranocartilaginous portion. Three consecutive pH readings were taken at one-half minute intervals (Table).

*Data on the pH of the Cutaneous Surface of the Affected External Auditory Canal in Eleven Adults with Otitis Externa*

| Patient | Sex | pH of the Affected Cutaneous Surface of the External Auditory Canal (Otitis Externa) |
|---|---|---|
| 1 | M | 7.3<br>7.3<br>7.4 |
| 2 | M | 7.6<br>7.6<br>7.6 |
| 3 | M | 7.5<br>7.5<br>7.5 |
| 4 | M | 7.2<br>7.1<br>7.2 |
| 5 | F | 7.3<br>7.3<br>7.3 |
| 6 | M | 7.7<br>7.8<br>7.7 |
| 7 | F | 7.2<br>7.2<br>7.1 |
| 8 | M | 7.8<br>7.6<br>7.8 |
| 9 | M | 7.6<br>7.7<br>7.7 |
| 10 | M | 7.6<br>7.5<br>7.6 |
| 11 | F | 7.4<br>7.3<br>7.3 |

In the men the pH range of the skin of the affected external auditory canal evincing otitis externa was found to be from 7.1 to 7.8. In the women, the pH range of the skin of the affected external auditory canal evincing otitis externa was found to be from 7.1 to 7.4.

## Summary and Conclusions

Although rational selection of medication for the topical treatment of infections of the external auditory canal depends in great measure on the bacteriology of the infectious process, a factor of considerable therapeutic importance is the pH of solutions applied to the skin of the external auditory canal. Susceptibility to infection is frequently due to the removal of the antibacterial "acid mantle" of the skin and its displacement by an abnormal, unphysiologic "alkaline mantle."

The introduction of a succession of new drugs has repeatedly seemed to solve the problem of otitis externa; yet clinical experience with various medicaments has invariably brought to light shortcomings that often counterbalanced any effectiveness these agents were thought to possess. The difference in effectiveness of two apparently similar agents is due to the ability of one medicament to produce or enhance a state of acidity, while the other produces or enhances a state of alkalinity that provides fertile soil for the propagation of infection. Bacteria and fungi have their finest opportunity for growth and multiplication when the continuity of the epithelial lining is interrupted and the surface milieu is changed from a normal acid state to an abnormal alkaline state. These properties are enhanced by the use of solutions in the external auditory canal whose pH is alkaline.

In the present investigation, measurement of the pH of the affected cutaneous surface of the external auditory canal was undertaken in 11 men and women with otitis externa. In the men, the pH range was found to be from 7.1 to 7.8. In the women, the pH range was found to be from 7.1 to 7.4. These findings emphasize the need for converting the abnormal alkaline state of the cutaneous surface of the external auditory canal in otitis externa to a desirable, normal, physiologic acid state.

185 N. Wabash Ave. (1).

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# Potentiated Anesthesia Derived from Artificial Hibernation

*Its Use in Bronchoesophagology*

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Until today and in accordance with Jackson's principles, all endoscopic work—direct laryngoscopies, bronchoscopies, and esophagoscopies—has been done with the use of the least possible amount of local anesthesia. According to the Philadelphia School, the ideal would be to use none at all, especially in children. General anesthesia would be, therefore, the exception in peroral endoscopy. In Latin countries, especially in Cuba, this conviction has been greatly modified and is followed at present in various countries for routine endoscopic work. In our country, general anesthesia is increasingly employed not only in bronchoesophagologic cases but also in any surgical operation, owing perhaps to three main factors: 1. Anesthesiology has made remarkable advances in these last decades. New drugs, new techniques, and new equipment have greatly improved this adjuvant branch of medicine, particularly in regard to safety and efficacy. 2. The Latin patient does not react in the same way as the American or Anglo-Saxon patient. Our patients, and I speak now of Cuban patients, are easily excitable and generally lacking patience; they do not have the discipline of character we have always admired in North American patients, which is apparently related to ethnological features. Therefore, they are not ideal patients for local anesthesia. 3. Owing perhaps to the fact that this generation has gone through the hardships and sufferings of two wars and numerous social and economic upheavals, patients avoid anything that could make them suffer. Most patients refuse discomfort or pain and are grateful to physicians who try to avoid them. Many patients insist and urge that we use general anesthetic.

In addition, we can work with greater comfort, accuracy, and tranquillity with a quiet patient under general anesthesia, without active resistance, resulting, in the end, in better efficiency for the surgical intervention and less trauma inflicted on patients.

The use of general anesthesia in bronchoesophagoscopy has always been a controversial problem, and it has been difficult to reach an agreement in this matter. But in Cuba, as well as in all other countries, even in the United States, local anesthesia in bronchoesophagology is losing adherents, in contrast to general anesthesia, which is winning them. With reference to the United States, for years some physicians, as Dr. Sam Roberts, of Kansas City, Mo., have preferred general anesthesia. According to this author, the method of immobilizing children (wrapping them as a mummy) and practicing endoscopic intervention without any anesthesia at all "appears neither humane nor necessary."

In a panel discussion that took place during the meeting of the American Broncho-Esophagological Association in March, 1955, dealing exclusively with "Anesthesia in Bronchoesophagology," this problem was approached from all angles, not only by those on the panel but also by the members pres-

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ent. A particularly interesting report was that of Dr. Chevalier L. Jackson regarding a survey on the anesthesia used and advised by bronchoesophagoscopists, from five hospitals in Philadelphia. The general opinion was in favor of the use of local anesthesia with premedication in routine measures; their choice for general anesthesia was ether rather than thiopental (Pentothal) with or without curare. Dr. Jackson prefers use of thiopental for adults and ether for children. However, he thinks that with the development of modern anesthesiology the risk of general anesthesia has been greatly reduced, and that we can hope it will be used in the future more frequently.

Up to now, my colleagues and I have not been satisfied with the general anesthesia employed in peroral endoscopy. Thiopental does not suppress the pharyngolaryngeal reflex, even in patients soundly asleep; respiration is greatly depressed, being the reason for the preference of anesthetists for tracheal intubation with this type of anesthetic, which limits its use to esophagoscopies. Ether greatly increases the secretions, and the postoperative period, as with thiopental, is stormy on account of vomiting, abundant secretions, easy bleeding, etc. Neither anesthetic, moreover, lacks risks.

The appearance in France of potentiated anesthesia stimulated our using it in bronchoesophagology, giving us excellent results almost at once. The fact that no report of its use in bronchoesophagology has appeared in the medical literature, so far as we can determine, encouraged us to describe our technique as well as the results. In the panel discussion at the meeting of the American Broncho-Esophagological Association referred to above this type of anesthesia was not mentioned.

The anesthesia proposed and advised by us has all the characteristics of general anesthesia, yet actually it is not; for only seldom must it be reinforced or made more extensive with an anesthetic of the thiopental type: It is the potentiated anesthesia introduced in surgery and medicine by the Frenchman, Dr. Henri Laborit. With this method, through pharmacodynamic agents often of little toxicity or strictly atoxic and having little or no anesthetic action by themselves, we try to place the human body in such condition that local or general anesthetics of little potency given in dosage inadequate to produce narcosis for a major surgical intervention assure an efficient general anesthesia. The patients thus treated remain in a living condition of slow rhythm, in one progressive mitigation of the physiobiological phenomena, in hypometabolism. As the patient is in a hypothermic condition, in a mitigated life condition similar to that of hibernating animals, the procedure has been called "artificial hibernation." The anesthesia obtained under artificial hibernation is then potentiated. It is what Huguenard has called "anesthesia without anesthetics," and, actually, even though the patient is anesthetized, the encephalographic tracing under potentiated anesthesia shows (Dupley, Pesle, and Martin, in a paper read before the Société de Neurologie, Paris, June, 1951) the wave of normal sleep, not the one produced by narcosis.

### Artificial Hibernation

What do we mean by artificial hibernation?

First, let us say that it is neither what Simpson [16] called "cold narcosis" nor a general hypothermia induced under narcosis. It is a pharmacodynamic method that gathers together in a "cocktail" vegetativolytic drugs which accomplish a homeostatic neuroplegia or controlled inhibition of the neurovegetative system. It leads to a mitigated life state with hypometabolism and crepuscular sleep; the hypothermia, which appears naturally without refrigeration, is only the reflex of this hypometabolism. The patient under artificial hibernation experiences a total decrease of his reactions to trauma, for example, as occurs in the golden hibernant rat, dormouse, and marmot during their sleep or hibernal lethargy, in which their body metabolism is reduced to a minimum, mitigating most of their vital functions,

above all, nutrition and relation. This allows them to ward off the hardships of bad weather, resist the harshness of cold weather, and, thus, avoid the need of emigration. These animals during their hibernal sleep show a lethargic condition in which their energy waste is 1/20 to 1/70 of their summer waste. An endocrine basis is accepted as the origin of this adaptation or functional reorganization, i. e., involution of the anterior pituitary, of the thyroid, and of the adrenal cortex. The artificially hibernated person would be in a similar condition.

At present, it is accepted that the human body always reacts the same way against all types of injury. Selye has proved the importance of the pituitary-thyroid-adrenal association in this reaction. The common syndrome involves vasodilation, capillary hypermeability, and edema. This sequence of events constitutes the Reilly phenomenon. What we accomplish with artificial hibernation (called by Professor Delay "hibernotherapy") is a neuroendocrine inhibition or neuroplegia. In a patient made neuroplegic by potentiated anesthesia there are no reactive disorders against trauma or they are totally mitigated.

In other words, artificial hibernation induces a diffuse blockade of the entire autonomic nervous system, in the periphery, and at the synapses and centers. In this manner, the patient whose autonomic system is unable to react to trauma would be protected against the shock arising from his own reactive defenses. This explains the ease of the anesthesia obtained through this condition of mitigated life, of hypometabolism, of neurovegetative and neuroendocrine inhibition, and the effective protection obtained against shock and post-traumatic disease.

### Induction of Artificial Hibernation

Pharmacodynamic blockade of the neurovegetative system, the essential stage for production of hibernation, is obtained by means of a lytic "cocktail," at present well regulated. This "cocktail" consists of the progressive parenteral administration of small doses of various drugs. Although it is advised that lytic combinations be changed when a patient is to be hibernated at different times, we have obtained perfect results with the same combination in the same patient, having performed four bronchoscopies in one patient in less than 15 days, without producing addiction.

The drugs we use, following the suggestions of Laborit, are (1) chlorpromazine (Largactil) hydrochloride, (2) promethazine (Phenergan) hydrochloride, (3) meperidine (Demerol, Dolosal) hydrochloride, and (4) diethazine (Diparcol) hydrochloride.

Chlorpromazine (2-chloro-10-[3-dimethylaminopropyl]phenothiazine) hydrochloride is a drug synthesized in France by M. P. Charpentier in December, 1950, at the Laboratories Rhone-Poulenc-Spezia. In Germany it is known as Megaphen, in the United States as Thorazine, in Sweden as Hibernal, and in Argentina and Brazil as Ampliactil and Amplictil, respectively. It is a sedative, antiemetic, and the most powerful potentiator. It stimulates respiration and is a strong inhibitor of the sympathetic system (sympatholytic) and of the vagus (vagolytic). It produces hypothermia by peripheral vasodilation. After its injection, the patient becomes apathetic, sleepy, remarkably unconcerned, and quiet. The body temperature greatly drops; there are muscular weakness, cold sensation, and thirst. The skin is warm, rather pale, and dry. Respiration is deep and regular; blood pressure falls slightly, and there is a moderate tachycardia, the pulse rate being about 90. Although the patient sleeps, can be awakened easily, and answers all questions, he shows a psychic indifference toward himself as well as toward those around him. The mental effect of chlorpromazine has been called by Lassner "pharmacodynamic frontal lobotomy." Its effect is summarized by Letiman and Hanrahan as follows: "Largactil is the only powerful sedative whose action is limited to a selective inhibition of

impulses." Because of this selective action upon the nervous system, the drug produces a ganglioplegic effect (Courvoisier), i. e., it interrupts the transmission of nervous stimuli at the sympathetic and parasympathetic ganglionic synapses.

Promethazine (N-[2-dimethylamino-2-methyl]-ethylphenothiazine) hydrochloride modifies basal metabolism, decreases muscular tonus, and has a hypnotic effect. It reduces capillary permeability and is an antishock medicament. It is a synthetic antihistaminic which controls bronchial spasms and is a mild analgesic.

Meperidine hydrochloride is an analgesic, sedative, antispasmodic drug, taking the place of morphine in the lytic "cocktail," for this drug has diuretic effects potentiated by the other components of the mixture. Meperidine is also vagolytic. It produces a useful amnesia. Its depressor effects upon respiration (bradypnea) are compensated by the eupneic effects of the other drugs. It is a mild hypotensor and reduces basal metabolism.

Diethazine (dimethylaminoethyl-thiodiphenylamine) hydrochloride, according to Huguenard,[6] is the axis of the lytic "cocktail"; it can be administered either by intramuscular or by intravenous injection. It causes inhibition of sympathetic and parasympathetic ganglia (sympatholytic and parasympatholytic) and produces hypothermia, reducing the body temperature about 4.5 F. It averts or eliminates bronchial spasm and is a respiratory analeptic, increasing the amplitude and frequency of respiration.

*Technique of Anesthesia.*—Anesthetization is carried out in two stages: (*a*) the day before and (*b*) the morning of the operation.

On the eve of the endoscopy, the patient takes 1 capsule of pentobarbital (Nembutal) of 0.1 or 0.2 gm., depending on his body weight and condition (nervous, alcoholic). We inject intramuscularly 50 mg. of promethazine (1 ampule).

One hour and half before the operation, we administer, by deep intramuscular injection, a "cocktail" composed of promethazine, 50 mg.; diethazine, 250 mg., and meperidine, 100 mg.

Finally, a half hour before operation, we initiate a venoclysis of 500 cc. of dextrose in water with 1 cc. of thiamine (vitamin $B_1$), 50 mg. of promethazine, 100 mg. of meperidine, and 50 mg. of chlorpromazine at a rate of 30-50 drops a minute.

A few moments before the patient enters the operating room, we pulverize into the pharynx 2% tetracaine (Pontocaine) hydrochloride or 10% cocaine, obtaining the patient's cooperation in spite of his somnolence and indifference. In the majority of cases, this local anesthesia can be avoided. If we are dealing with an emergency case, the first stage, of course, is omitted, i. e., the one carried out the day before.

*Patient's Appearance Under Artificial Hibernation.*—The artificially hibernated patient is in a condition of crepuscular sleep, totally unconscious with hypothermia, the body temperature oscillating from 91.4 F to 95 F, and with decreased respiratory rhythm and oxygen consumption; the cardiovascular system is adapted to the metabolic needs; the pituitary, thyroid, and adrenals are at functional rest. In spite of his appearance, the patient will react to strong excitations, including all questions asked in a loud voice, but upon waking, he will not remember anything. The pulse is strong; respiration is slow but ample, and the lips are well colored.

*Advantages of Artificial Hibernation.*—With this type of anesthesia we have never been compelled to use tracheal intubation, although we consider this procedure useful for esophagoscopy in young patients, for the esophagoscope can compress the trachea. Since there are total muscular relaxation and dryness of the mucous membranes (without sialorrhea or bronchorrhea) and since crises of apnea are seldom present, there is no need for the use of the tracheal tube.

Neither glottic spasm nor shock has been present, even when the operation is prolonged.

Regardless of the operation, with this anesthesia the postoperative period is excellent and its management very simple: The patient awakes after three or four hours, sometimes before, not remembering the surgical intervention in spite of his co-

operation having been requested during the operation. He experiences no postoperative pain or vomiting; nor does he exhibit hiccups or coughing, although he can cough when ordered. At all times, pulse and respiration are ample, and contractures or chills have not been observed.

The wounds have no tendency to bleed, an advantage in cases in which we have coagulated or removed a hemorrhagiparous tumor. On awakening, the patient looks and is euphoric, among other reasons because he knows the operation is over and he has not suffered, nor is he suffering. If necessary, he can return home the evening of the day of operation and can be fed as soon as he is conscious.

Theoretically, the criticisms made of other general anesthesias in bronchoesophagology can also be directed toward this technique, i. e., that the patient cannot cough; that he cannot indicate when respiration is failing or whether the operation is too painful; that the presence of the anesthetist complicates free movement and the endoscopic technique, and, finally, that this anesthesia seems too complicated for an intervention lasting, at times, one minute or less. However, hibernated patients have no need of coughing, for the siccative, bronchodilator, eupneic, antianoxic, and antiedemic effects of the lytic "cocktail" avoid respiratory disturbances; we can ask the patient whether he feels some pain; the anesthetist is not near the surgeon; actually, he does not even need to be in the operating room, once the good condition of the anesthetized patient is assured. Induction of the anesthesia is virtually uncomplicated; a trained nurse is able to perform it without any fear at all. Furthermore, its advantages compensate for any nuisance.

Besides, personally, we have had no accidents whatsoever, even in long-lasting operations, in spite of having used the method often.

*Precautions and Complications.*—The following precautions are advised:

1. To avoid overdoses of drugs employed; the vegetative type of patients must have particular study in this regard.

2. To avoid sudden postural changes while moving the patient from one place to another; the vasoplegia could induce cardiac disturbances.

3. To have a staff trained not only for the application of artificial hibernation but also for the observation of the patient until he awakens.

There are no contraindications. On the contrary, since all shock is avoided with this procedure, it could be used for patients with pathological histories or cachexia and even for hypoxemic patients.

Although artificial hibernation is the anesthesia of choice for adults, we have used it even for 6-year-old children.

## Dehibernation

Even though the patient recovers from the anesthesia within four to six hours, this period can be moderately shortened; but one must not suddenly dehibernate a patient, above all when he is in a deep hypothermic condition. Such sudden dehibernation carries the risk of leading to anoxemia, since the respiratory rhythm is in no condition to supply the oxygen need. This is why one should not administer analeptics such as camphor or epinephrine; but one may use ephedrine, caffeine, and ouabain, which are effective and not dangerous.

## Summary

In Cuba and in many other countries, general anesthesia is increasingly employed in bronchoesophagology. Any type of general anesthesia used in peroral endoscopy up to now has faults and inconveniences as well as notorious dangers. Postoperative disturbances due to general anesthesia have been legion.

Potentiated anesthesia derived from artificial hibernation has been extensively used in France, where it was created, in the rest of Europe, Canada, Cuba, Mexico, and various countries of South America. It has

TABLE 1.—*Summary of Endoscopies Performed in 1954 and 1955*

| Type of Anesthesia | | No. of Endoscopies |
|---|---|---|
| Local | | 497 |
| General | | 189 (27%) |
| Potentiated | 109 | |
| Other | 80 | |
| Total | | 686 |

proved its efficacy in any type of operation, regardless of how complicated or prolonged, reducing the amount of anesthetic to be employed to a minimum, avoiding shock and postanesthetic side-reactions, and simplifying the application of anesthesia and the anesthetist's actions.

We have used this anesthesia in many bronchoesophagologic cases with great success, being able to work in the larynx,

TABLE 2.—*Endoscopies Performed 1954-1955 with Use of Potentiated Anesthesia*

| Purpose | No. of Cases |
|---|---|
| Direct laryngoscopy | 15 |
| Diagnostic bronchoscopy | 26 |
| Diagnostic esophagoscopy | 19 |
| Dilatation of tracheal stenosis | 11 |
| Removal of foreign body | |
| Bronchial | 4 |
| Esophageal | 9 |
| Endoscopic treatment of bronchial tumor | 5 |
| Sclerosing injection of esophageal varices | 6 |
| Bronchial biopsy | 10 |
| Esophageal biopsy | 4 |
| Total | 109 |

bronchi, and esophagus without haste, with safety and ease, without discomfort for the patients, and without the need of sacrificing efficiency to brevity of the operation.

Daily routine endoscopic work will continue to be done with local anesthesia; but when a general anesthesia in a bronchoesophagologic case is indicated (and these indications are increasing day by day) the "anesthesia without anesthetics," artificial hibernation, is, in our opinion, a sensational acquisition.

Anesthetization by artificial hibernation is indicated, as was just said, in all endoscopic cases in which a general anesthesia is desired:

(*a*) In adult patients who for one reason or another do not cooperate.

(*b*) In patients with local pain which local anesthesia is unable to control.

(*c*) In older children who cannot be immobilized because they are too strong and are not yet mature enough to give absolute cooperation in spite of sedation.

(*d*) In cases of foreign bodies in the esophagus in which the foreign object is too large or tightly impacted, so that a maximum of relaxation is necessary.

(*e*) In frightened patients.

(*f*) In excited or nervous patients; in those nervous patients with heightened reflexes who fight, it is possible to produce trauma during the endoscopy, resulting in a disagreeable remembrance; when anesthesia is poor or insufficient, the intervention is, in such a case, inadequate and risky.

(*g*) In those who, even though willing, are unable to relax the neck and jaw adequately or who have some anatomic handicap.

(*h*) In cases in which a prolonged intervention may be necessary.

(*i*) In those patients for whom previous endoscopies with local anesthesia have not been successful on account of lack of time, poor cooperation, etc., as in cases of removal of foreign bodies embedded in bronchi, difficult biopsy, profuse bleeding, etc.

(*j*) In those patients with history of toxic reactions to local anesthetics.

(*k*) In those patients insisting on receiving general anesthesia in order to reduce suffering, patients who, as we said at the beginning of this paper, are daily increasing in number.

(*l*) When the temperament of the surgeon compels him to use general anesthesia unless there is a definite contraindication.

(*m*) In suspension laryngoscopy.

(*n*) In very old patients with increased surgical risk.

It is necessary that we insist, once again, that we are not proposing employment of this anesthesia as a general rule, for much of the routine bronchoesophagologic work can be performed with the use of local anesthesia. Yet we do think that in these present

days, and in the near future, general anesthesia will be employed more and more. Because of its great advantages, we advise the use of this potentiated anesthesia derived from artificial hibernation.

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# Management of Fractures and Soft-Tissue Injuries About the Face

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Whenever possible, soft-tissue injuries of the face should receive attention within a few hours after the accident. The early treatment of facial lacerations not only limits the degree of inflammatory reaction but also reduces the amount of subsequent scarring and distortion of the affected part. Hydrogen peroxide is a most effective agent for the removal of debris and coagulated blood from lacerated wounds, leaving clean tissues for suturing.

The ultimate formation of scar tissue always is diminished by sharp excision of rough, irregular, ragged, or macerated margins of wounds. Furthermore, lacerations which have been cut on the oblique require excision of the edges of skin in order that they will be perpendicular to the external dermal surface; this is essential for proper suturing of the wound. Portions of skin in which the blood supply is so poor that sloughing is likely to occur should be removed promptly. Since the formation of a hematoma is most undesirable, it is extremely important that no facial wound be closed before bleeding has been completely controlled by ligating all vessels which continue to ooze. Although it makes little difference what type of suture material is employed to approximate the skin edges of a laceration, heavy sutures which include large amounts of tissue are unsatisfactory because they produce a great deal of unnecessary scarring. Neat, small stitches of fine material such as silk are essential in securing a satisfactory cosmetic result. After a facial wound is closed application of a pressure dressing, which should be left undisturbed for 48 to 72 hours, is extremely helpful; such dressings promote rapid healing and further obviate the possibility of a hematoma.

The use of a free skin graft, whether of the split-thickness or full-thickness variety, should be considered in the immediate repair of facial lacerations in which there is a loss of skin. Such grafts prevent a great deal of scarring and distortion of the involved part and are recommended providing there is no evidence of gross contamination of the wound. If the denuded area is not too large, a full-thickness graft dissected from the posterior auricular region is preferable to a graft from any other site because the color of the skin in this situation closely resembles that of the face. Moreover, such grafts heal extremely well. When a large graft is required, however, a split-thickness or shave graft from the abdomen or thigh or a full-thickness skin graft from the clavicular region has to be used. Shave grafts usually take satisfactorily but are too white and often later become deeply pigmented. Full-thickness skin grafts from the clavicular region, on the other hand, have an acceptable color but, in my experience, often are inclined to slough because of their thickness. In general, however, the act of adapting a dermal graft to tissues recently denuded of skin is successful, and thus prevents scarring and distortion, which are inevitable when such wounds are left to epithelize spontaneously.

In traumatic facial surgery, one inexcusable error in technique is failure to remove from abraded and lacerated surfaces dirt

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and other pigmented foreign material by vigorous scrubbing with a stiff brush, soap and water. If permitted to remain in a wound, such foreign substances leave a permanent tattoo-like pigmentation in the skin which is impossible to remove except by excision.

Occasionally, a penetrating laceration of the cheek will divide Stensen's duct and result in an external salivary fistula. Numerous operations have been devised to anastomose the cut ends of the duct. However, in my experience, attempts to repair the duct usually are unsuccessful. Fortunately, in these cases nothing more is required than insertion of a Penrose drain from the mouth into the lacerated region of the cheek through a stab wound adjacent to the distal part of the duct. The external wound may then be tightly sutured. Such management encourages the flow of saliva to follow the Penrose drain into the mouth and opposes the development of an external salivary fistula. Ultimately, this artificial opening into the mouth forms a part of Stensen's duct and functions in a completely normal manner.

## Fractures

The early treatment of injuries to the bony structures of the face is never urgent as is the care of wounds of soft tissues. In fact, it often is preferable to defer the reduction and immobilization of fractured facial bones until satisfactory roentgenograms can be secured and until the course of treatment can be well planned.

*Nasal Bones.*—Fractures of nasal bones can be divided into three categories: (1) recent fractures of the nasal bones and nasal septum; (2) severe crushing injuries to the nose in which the nasal bones are driven into the ethmoid region; such injuries are associated with fractures of the ethmoid bone and often lateral displacement of the mesial walls of the orbits, and (3) nasal deformities due to old fractures of the nasal bones and septum.

The treatment of the simpler forms of nasal fractures is well known. Usually, internal or external manipulation is all that is required for reduction. Intranasal petrolatum-gauze packs and an external metal splint are sometimes necessary to maintain the nasal bones in proper position.

Severe crushing injuries to the nose are serious because they invariably are associated with fractures of the cribriform plate of the ethmoid bone. Consequently, cerebrospinal fluid drains from the nose and there is some danger that meningitis may develop. The immediate treatment in such cases involves administration of penicillin and perhaps one of the other antibiotics as well to prevent intracranial infection. Reduction of the nasal fractures should be delayed until the patient's general condition is satisfactory. It is useless to elevate badly comminuted and depressed nasal bones unless some form of fixation is available for retaining the nasal bones in proper position. One effective method is to employ external metal plates through which are threaded wires that pass horizontally through the nose. These plates and wires tend to hold the nasal bones inward, thus narrowing and elevating the bridge of the nose. If the mesial walls of the orbits are pushed laterally, it is extremely important to manipulate the bony fragments into normal position and immobilize them with metal plates as soon as the patient's general condition will permit such treatment.

Nasal deformities due to old fractures of the nasal bones and septum can be repaired only by rhinoplastic operations, a subject which cannot be discussed in this paper. However, if the defect involves a depression of the nasal bridge, the use of a cartilage or bone graft to build up the nose to normal contour is indicated. I believe that no foreign substance should be used for this purpose. Fresh autogenous cartilage implants have the disadvantage of warping and becoming distorted. Cartilage obtained at necropsy, on the other hand, will not warp but has a marked tendency to undergo absorption. Because of these undesirable

features, I have practically discontinued the use of cartilage for nasal implantation. Instead, I prefer to use cancellous bone from the crest of the ilium. A bone graft from which the hard cortex has been removed heals readily, and since it is composed largely of cancellous bone, it can be easily cut to the desired shape by the use of rongeurs and files.

The degree of displacement of a depressed fractured malar bone cannot be determined on palpation. Roentgenograms are absolutely essential, and the anteroposterior view in the Water's position seems to give the most satisfactory information with regard to displacement of a fractured zygoma. Fractures of the malar bones can be divided into four groups: (1) uncomminuted fractures less than a week old, (2) uncomminuted fractures from one to four or five weeks old, (3) comminuted fractures up to five or six weeks old, and (4) fractures more than five or six weeks old.

For uncomminuted fractures less than a week old, the treatment is not difficult. A small curved forceps inserted through a tiny incision in the skin is an effective instrument for elevating the displaced bone; fixation is not necessary. However, if six, seven, or more days have elapsed before an uncomminuted malar bone is elevated, the bone will not stay in proper position without some form of fixation. Consequently, an uncomminuted fracture of a malar bone which is one to five weeks old can be easily elevated, but some form of immobilization is required to maintain the bone in satisfactory alignment. This can be accomplished in either of two ways. The first is fixation by direct wiring. This technique necessitates three small incisions: along the lateral and inferior edges of the orbit and along the zygomatic arch. Small holes can be drilled and the fragments held together with heavy chromic absorbable surgical (gut) sutures or stainless steel wire. The second method of obtaining immobilization is exposure of the antrum through a Caldwell-Luc opening, elevation of the depressed malar bone, and immobilization by means of an intra-antral iodoform pack. I prefer the latter method, which, in general, is simpler and just as effective as the former technique.

When a malar bone is badly comminuted, I believe that the antrum should be opened through a Caldwell-Luc exposure so that the surgeon can insert an index finger within the antral cavity to manipulate the fragments into correct alignment. For immobilization, an intra-antral gauze pack is inserted and left for from two and one-half to three weeks. In addition to the pack, a Penrose drain inserted into the maxillary sinus will permit the escape of any infected material or discharge which may accumulate within the antral cavity. Ocular palsies caused by injury of the floor of the orbit are frequently distressing complications of comminuted fractures of the malar bones. Manipulation of the fragments from within the antrum will sometimes correct the ocular symptoms, but in many cases it is not possible to replace the fragments so that the extraocular muscles will function normally. The floor of the orbit may be so badly comminuted and depressed with loss of fragments of bone that the eyeball drops down a few millimeters due to lack of support. If intra-antral manipulation does not correct this difficulty, the floor of the orbit can later be rebuilt with a cancellous bone graft from the crest of the ilium. Such grafts are very satisfactory; although they do not restore normal movements of the eyeball, they do hold the globe up in normal position.

Fractures of malar bones which are more than five or six weeks old present a special problem. Attempts to restore the position of such a malar bone usually are rather unsuccessful. The bone can be elevated, but it is inclined to become displaced gradually in spite of any form of fixation. Consequently, in these cases I prefer to build up the flattened cheek to more nearly normal contour by means of cancellous bone chips from the crest of the ilium. Working through an incision in the temporal region,

the skin over the depressed zygomatic region is elevated to form a pocket into which the crushed cancellous bone chips are introduced. Molding of the cancellous bone mass to proper contour is accomplished with finger pressure, and healing occurs rapidly.

*Maxilla.*—From the standpoint of treatment, I have found it convenient to classify fractures of the upper jaw in four groups: (1) fractures of the facial bones in which there is complete separation of the upper jaw from the rest of the skull, (2) horizontal fractures of the maxilla associated with one or more fractures of the alveolar process and palate, (3) unilateral fractures of the upper jaw, and (4) fractures of the upper alveolar process. Every fracture of the maxilla will fit into one or the other of these four categories, and there is a specific form of treatment for each group.

The first group of maxillary injuries involves three types of fractures: the horizontal maxillary fracture, the pyramidal facial fracture, and the transverse facial fracture. The last two types are frequently associated with a fracture of the cribriform plate of the ethmoid bone, and the patient exhibits cerebrospinal rhinorrhea. The initial treatment of pyramidal and transverse facial fractures should consist in the administration of penicillin or another antibiotic drug to prevent meningitis. Reduction of the fractures should be postponed until the patient's general condition is satisfactory. Regardless of how freely movable any one of these three types of fractures of the upper jaw may be, it usually is not possible to manipulate the maxilla into correct position. To secure good occlusion of the dental arches, one must resort to elastic traction for reduction of the fracture. This involves the application of hooked arch bars to the teeth and the use of intermaxillary elastic bands to bring the teeth into occlusion. In my experience, the most satisfactory method of immobilizing such fractures is the use of traction wires which are attached to the upper arch bar, passed through the cheeks, and fixed to a plaster head cap. In an edentulous, fractured upper jaw, the traction wires can be attached to the patient's upper denture. These traction wires are not uncomfortable and maintain adequate fixation of the upper jaw for any desired length of time. In cases of horizontal maxillary and pyramidal facial fractures in which the malar bones are not injured, the traction wires can be attached to the inferior rims of the orbits. Immobilization of these three types of fractures should be maintained for four weeks.

The second group of fractured upper jaws (horizontal fractures of the maxilla associated with one or more fractures of the alveolar process and palate) requires treatment similar to that in Group 1. The teeth are brought into occlusion by intermaxillary elastic traction. Because of the fact that the alveolar process is broken into segments, a full hooked arch bar cannot be applied to the upper teeth. Consequently, if traction wires are employed, they must be attached to the lower arch bar. Such wires fix the mandible, which, in turn, immobilizes the fractures of the upper jaw. The third and fourth groups of fractures involving the maxilla are dental problems and will not be considered.

## Comment

If satisfactory cosmetic results in the treatment of facial injuries are to be obtained, I think that the following factors should be emphasized: early treatment and proper débridement of facial lacerations, complete hemostasis, use of fine skin suture material and pressure dressings. Much unnecessary scarring and disfigurement of the face could be prevented by the immediate application of free skin grafts to regions denuded of skin. In the management of fractured facial bones, immediate treatment is not so important; of more significance is careful preoperative planning.

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# Cogan's Syndrome

*Report of Two Cases with Signs and Symptoms Suggesting Periarteritis Nodosa*

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Two cases of Cogan's syndrome are the subject of this report. Both had systemic signs and symptoms of periarteritis nodosa. At least two other cases have occurred in the past three years in hospitals with which I am associated. The records of these are not available at this time. The possibility that this condition is present but unrecognized in other otolaryngologists' practices prompts the writing of this paper.

A description of Cogan's syndrome as first reported by him in 1945 [1] follows: The signs include ciliary injection and a granular-type corneal infiltration with patchy distribution (yellowish patches, between which the cornea is clear). The infiltration is situated predominantly in the posterior half of the cornea. Later the cornea becomes vascularized. Three of four cases have a chronic course, varying in severity from day to day. No reaction occurs in the anterior chamber or iris. The fundus is normal. Biomicroscopic examination shows glistening infiltration, interpreted as cholesterol crystals. The ear symptoms include severe vertigo, tinnitus, nystagmus, and rapid, progressive deafness. Elevation of the white blood cell count, sedimentation rate, and eosinophile count are the only evidence of systemic disease. Young male adults are oftener affected.

Oliner and associates [4] described a case of Cogan's syndrome associated with periarteritis nodosa; McNeil and co-workers,[5] a case of periarteritis nodosa, causing deafness in an adult. This latter case was confirmed by autopsy. The eighth nerve showed degeneration regarded as due to ischemia; the labyrinth was not examined. Bell [3] describes periarteritis nodosa as a diffuse infiltration of the small and medium arteries in various parts of the body by mononuclear leucocytes and a few polymorphonuclear and eosinophilic cells. This causes a nodular swelling of the vessels with normal areas between. The swelling may occlude the lumen. Infarcts and aneurysm may occur from weakening of the wall. These are healed by fibrosis and encircling bands of fibrous tissue. The lesions may occur in any tissue. The usual opinion is that the cause is an antigen-antibody reaction in a hypersensitive person. A family history of allergy or allergic tendency in the patient is present in a fair per cent of the cases.

CASE 1.—A 28-year-old salesman developed fever (101.0 F), diarrhea, and cough in August, 1953. These persisted, and three weeks later inflammation of the eyes, bilateral deafness, vertigo, tinnitus, and nausea developed. He walked like an intoxicated man. He complained of intermittent drowsiness and slight stiffness of the neck. There was no history of allergy. He was first seen elsewhere and was said to have had diffuse lymphadenopathy, splenomegaly, and hepatomegaly. The eye findings were described by an ophthalmologist as an interstitial keratitis with patchy infiltration of the deep corneal layers. The following were normal: blood cell count, spinal fluid, urine, stool, blood serology, sedimentation rate, total blood protein, albumin and globulin, fasting blood sugar, calcium, phosphorus, alkaline phosphatase, blood culture, agglutination tests for numerous virus diseases, eye culture, cat-scratch fever skin test, and injection of eye secretions into a white mouse and embryonated egg. Positive reactions were obtained to ragweed, parathyroid B, and heterophile (questionable) agglutination tests. X-rays of the gastrointestinal tract, heart, lungs, skull, and mastoids were normal. The physical findings were as follows: reflexes sluggish, no response to cold caloric; deafness, moderately severe in left ear, severe in the right, nerve type. Treatment: The patient remained in the hospital for several months; the only effective medication was cortisone in the eye. Oxytetracycline (Terra-

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mycin), chlortetracycline (Aureomycin), and cortisone by mouth did not seem to help. The patient has a residual, severe deafness and tends to walk to the right. His eye symptoms and diarrhea still recur periodically. (On this patient's chart it is noted by the neurological resident that another, almost identical case was being treated on her ward. This patient's symptoms began in June, 1953, and he became very deaf. The hearing returned to nearly normal by September, but some minimal eye signs remained in December, when he was discharged.)

CASE 2.—A 27-year-old man, an Italian salesman, developed sudden vertigo, nausea, vomiting, and tinnitus while at work about Jan. 20, 1956. Within two days, a profound deafness occurred in both ears, with loss of balance and continued vertigo. He was hospitalized and given cortisone, streptomycin sulfate, and vitamins. An interstitial keratitis with a conjunctivitis developed in both eyes. This involved the deep layers of the cornea, especially at the periphery. His condition improved and he went home, but the next day he had a flare-up in both eyes and the ears. He was again hospitalized. On this occasion, in addition to the labyrinthitis and keratitis, he had drowsiness, diarrhea, abdominal cramps, pains in his legs, and tenderness along the carotid and femoral vessels. He ran a febrile course with a temperature up to 104.0 F, the hearing loss for speech became total, and he had no response to the cold caloric. One month prior to the onset of vertigo, he had a severe diarrhea, unrelieved by antibiotics, but responding to cortisone. This had periodically recurred since. Three months before the onset of vertigo there was an episode of swollen neck glands, fever, and an enlarged liver and spleen. Since 1950, he has had attacks of backaches, chills, and fever, which he thought were from a recurring prostatitis contracted in the Navy. He has no known allergies. His mother is an asthmatic. His father died of tuberculosis. The following examinations were done: cerebral spinal fluid negative; stool examination showed Ascaris ova on one occasion and was negative on another; white blood cell count ranged from 19,000-27,000; polymorphonuclear count from 69%-90%, on one occasion, eosinophiles 6%; serology negative; heterophile negative. Tests for lymphocytic choriomeningitis, lymphogranuloma venereum (Frei), brucellosis, trichinosis, Leptospira icterohaemorrhagiae, L. canicola, and L. pomona were negative. Repeated blood cultures and two muscle biopsies were negative. Studies for brain abscess and brain tumor showed no evidence of these. Penicillin, chloramphenicol (Chloromycetin), and streptomycin sulfate had no effect on the course. Cortisone caused remissions of gastrointestinal symptoms, muscular pain, and eye inflammation, but eventually ceased to be effective. Repeated transfusions have resulted in some improvement, except for the ear symptoms. He is still hospitalized.

## Summary

Two cases of Cogan's syndrome, with interstitial keratitis and nerve deafness, are described. These cases suggest a possible connection between Cogan's syndrome and periarteritis nodosa. Occular involvement occurs in 23% and nerve deafness in 3% of periarteritis cases.[4] In addition to a keratitis and nerve deafness, both cases had, during their course, adenopathy, enlarged spleen and liver, fever, diarrhea, and some signs or family history of allergy.

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## Audiology Section

Joseph Sataloff, Associate Editor

# Objective Audiometry

*Utilization of an Unconditioned Muscle Reflex for the Determination of Sound Perception*

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The vast majority of hearing tests carried out as routine procedures are based on the willingness and ability of the patient to report his hearing sensations. Realizing the disadvantages of subjective audiometry, it is not surprising that numerous attempts have been made to find a criterion by which the function of the hearing organ is determined by observations which are independent from statements of the patient.

A definition of terms is essential. We are concerned with objective quantitative measurements of the function of the cochlea in perceiving sound. The term "hearing" as connotating a cortical function is avoided, and emphasis is placed on the cochlear function. Sound perception and cochlear function are used here as synonyms. Objective audiometry is defined as the determination of sound perception which is not based on the sensations or descriptions of the examined person.

This discussion deals with an unconditioned muscle reflex which is produced by acoustic stimulation. Numerous muscle reflexes have been described, among them the pinna reflex, the auditory lid reflex, the pupil reflex, and general muscle reflexes. All these reflexes have been found unsatisfactory for general routine quantitative tests.

A different position, however, is taken by the acoustic reflex of the muscles of the middle ear. The two muscles of the middle ear have been studied extensively in the animal experiment. There is no difficulty in exposing the middle-ear structures in rabbit, cat, or dog. Extensive and important observations have been made to clarify the function of the middle-ear muscles in the animal experiments. However, contradictory and confusing observations will be made if several principal physiological conditions are not heeded.

1. Reflex observation must be made under local anesthesia or extremely light general anesthesia.

2. The exposure of the middle-ear structures must be done in such a careful manner that any damage to important neck structures or ear structures is avoided. Tying-off the carotid arteries not only diminishes the blood supply but also interferes with sympathetic innervation.

3. The performance of the muscle reflex may be handicapped if there is local damage to the muscle belly within the middle ear. Under certain conditions oozing of blood into the middle-ear cavity has been seen to be damaging to the muscle performance. We make it a habit in our own experiments, therefore, to keep the middle-ear cavity

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completely dry and free from blood at all times during the experiment.

4. In order to study the reflex the onset of the stimulus is important. The acoustic stimulus must be as rectangular as possible. If the sound is permitted to increase gradually the threshold is lower, latency time longer, and the physiological principle of "creeping-in" may be observed.

5. The selection of the experimental animal is also important. The guinea pig and the monkey are not good experimental animals for studying the reflex. The reason may consist, as Frey pointed out, that certain animals have a physiological ankylosis of the hammer incus articulation. In these animals the reflex is not developed as regularly and intensively as in the canine, feline, or rabbit ear.

6. The reflex is best observed in the young (both animals and man).

The reflex arc has been studied in the animal. Pollak,[4] Hammerschlag,[1] and others have revealed the anatomy of the reflex. The afferent branch of the reflex is the acoustic nerve. The central part is represented in the acoustic nuclei and in association fibers with the trigeminus or facial nerve. The efferent branch is N. trigeminus for the tensor muscle and the facial nerve for the stapedius muscle. The reflex is maintained after removal of the cortex and after sectioning below the thalamus and corpora quadrigemina.

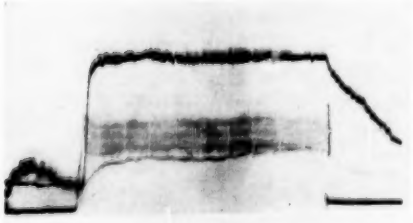


Fig. 1.—The physiological basis of the acoustic reflex of the intratympanic muscles. Rabbit in light general anesthesia.

Both the tensor tympani muscle and the stapedius muscle have been armed with small hooks, which are connected by fine threads to an optico-mechanical system. This records the reflex responses of the two muscles. Tone recorded simultaneously.

Note: Both muscles react synergistically with tetanic contractions, which begin with the onset and cease with the silencing of the tone stimulus.

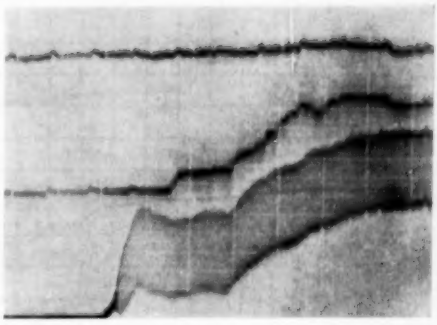


Fig. 2.—The influence of a tone increase on the stapedial reflex contraction.

Note: Increase of stapedius contraction parallel to tonal crescendo. Tensor tympani is below threshold of contraction.

Both muscles contract with a tetanic response which corresponds with the onset and termination of the acoustic stimulus. Figure 1 shows an optical recording of acoustic stimulus and the corresponding tetanic contraction of both middle-ear muscles. It can be seen that the stapedius has a brisker reflex with a shorter latency time. Figure 2 shows the parallel increase of the muscle contraction when the stimulus is increased. Repetition of acoustic stimulation demonstrates that the reflex is fairly free of early fatigue. Several stimuli can be repeated without showing diminished responses.

For the observation of an acoustic stapedius reflex in the human the following conditions are necessary: The hearing function at the side where the stimulus is applied must be satisfactory. The opposite ear might be impaired or even completely deaf. The reflex arch must be intact. The stapes or stapedius tendon must be visible through a perforation of the eardrum. The motility of these structures must not be impaired by adhesions, granulations, or secretion (Fig. 3).

The importance of the reflex for practical clinical purposes is naturally very limited, as long as a perforation or absence of the

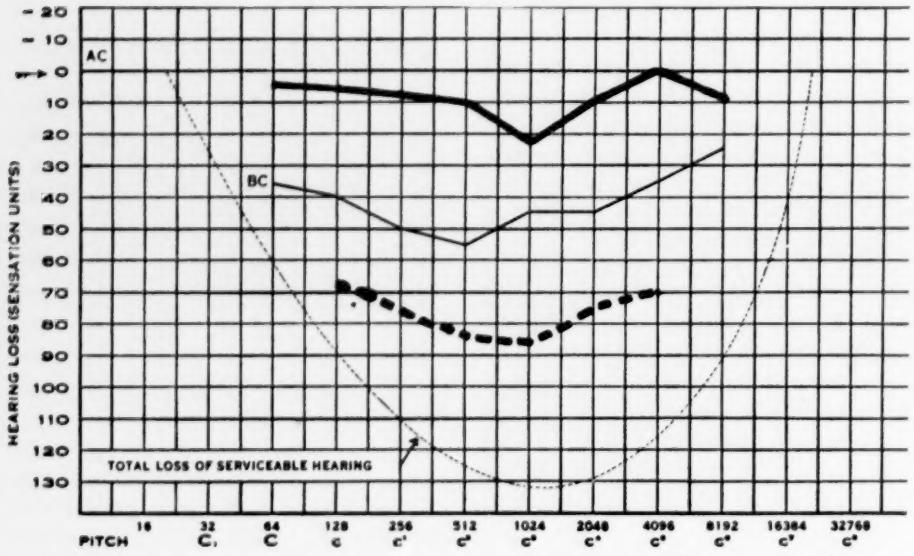


Fig. 3.—Chart of a patient whose acoustic stapedius reflex was observed through a perforation of the eardrum.

Solid line indicates threshold of hearing sensation. Broken line represents threshold of barely visible stapedius movement when observed with a + 13 diopter lens.

eardrum must be present for the visualization of the tendon. However, when found to be active, it does prove cochlear function. Nonacoustic reflex movements, e. g., those due to touch of the outer acoustic meatus, can be readily avoided.

The attempt was made to extend the observability of the tympanic muscle reflex to intact normal eardrums, which do not possess a perforation in the posterior-superior quadrant.

From physiological observations in animals it became clear that the two muscles in the middle ear contract vigorously but no movement of the eardrum can be seen when low or moderately strong optical magnifications are used. In common physiological terminology this type of contraction can be described as "isometric." All observations through the external auditory canal have been negative when a search was conducted to see movements during acoustic stimulation. Even when microscopes were used (Waar [5]) only negative findings were obtained.

It occurred to me that small movements of the eardrum must occur during acoustic tensor contractions and they must be smaller than previous experimental methods were able to reveal. A more sensitive method exists; it is simple and has been proved to be useful.

About 50 years ago, the German psychologist W. Köhler [3] in his doctorat dissertation presented his study of the effect of the tympanic muscles on the eardrum. He persuaded an otologist to have a tiny mirror glued on his own eardrum. When acoustic stimuli were given, movements of the eardrum were observed. For more than four decades this method was not repeated. Most likely it was assumed to be too difficult or too dangerous. Others may have believed the premises of the experiment to be erroneous.

I have undertaken to repeat Köhler's experiments.* In no way do I consider the method to be either difficult or dangerous. Naturally my method varies from Köhler's original procedure in several respects. When the mirror is attached, magnifying glasses

* Kobrak, H. G.: Paper read before the Acoustical Society of America, New York, June 24, 1954.

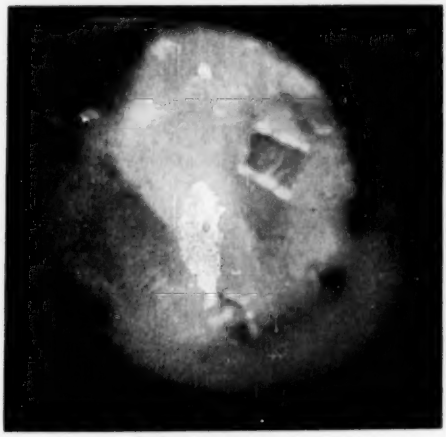

Fig. 4.—Eardrum of patient with two small plane mirrors attached. One mirror is on the superior-posterior quadrant, the area of maximum displacements on acoustic stimulation. The other mirror is in the umbo area.

Both the acoustic vibrations and the rotation due to muscle contraction are followed by the mirror satisfactorily.

Ointment is used as "glue." It is injected with a special "ointment syringe." No local anesthesia is given. For experiments on the muscle reflex, only a mirror in the umbo area is used.

are used. Instead of glue I use bland ointment, which is deposited in the umbo area in a small amount. The placing of the ointment is simple. It is injected by means of an "ointment syringe." The ointment syringe and the placing of small globes of ointment was developed for other reasons (Kobrak [2]), but the technical details are readily adaptable for the mirror attachment on the drum.

The initial experimental observations are concerned with exploring the order of magnitudes of the response and the signal-to-noise ratio. The undesirable background disturbances in this condition are the pulse, respiration, and movements of the head. The following results were obtained:

1. When a mirror is attached to the eardrum of a normal person the pulse and respiration produce certain minute movements.

2. When a loud tone is given two kinds of movements of the eardrum can be observed: (*a*) the acoustic vibrations and (*b*) a static, slow pulling motion away from the rest position.

On a young normal alert person the following results were obtained:

| | On Screen |
|---|---|
| Weak acoustic stimulation | 18 mm. |
| Medium strong acoustic stimulation | 30 mm. |
| Strong acoustic stimulation | 60 mm. |

These measurements indicate that the eardrum rotates the following angles:

| | |
|---|---|
| Weak acoustic stimulus causes a rotation of | $\sin \alpha = 0.00225 = 0°8'$ |
| Medium strong acoustic stimulus causes a rotation of | $\sin \alpha = 0.0038 = 0°13'$ |
| Strong acoustic stimulus causes a rotation of | $\sin \alpha = 0.008 = 0°27'$ |

3. The axis of the acoustic vibrations and that of the slow motion are not identical.

4. The slow movement begins with the onset of the tone and terminates with the cessation of the sound stimulus. The onset motion is considerably brisker than the return to the zero position on termination of the sound.

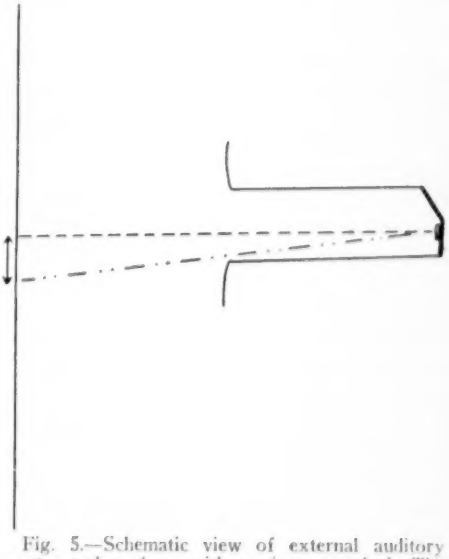

Fig. 5.—Schematic view of external auditory meatus and eardrum with a mirror attached. The deflection of a light beam is measured on a screen. By simple geometry, the rotation of the mirror can be measured.

Rotations of the hammer handle were observed between 15 second and 45 minute angles. Frequencies 1000 and 2000 cps are optimal for eliciting the reflex. Increase of tonal stimulus shows corresponding increase of reflex response.

| Angle of Rotation | Umbo Displacement |
|---|---|
| 4 minutes | 0.0044 mm. |
| 5 minutes | 0.006 mm. |
| 8 minutes | 0.0092 mm. |
| 13 minutes | 0.0152 mm. |
| 27 minutes | 0.032 mm. |

5. The quantity of the motion is as follows: A light lever of 4 m. is used. The light reflected from the eardrum by the mirror makes motions (those illustrated in Fig. 5) during acoustic stimulation on the screen.

Other persons had weaker responses: between 4 and 12 minutes rotation.

The linear displacements which occur during the rotation of the manubrium can be calculated. When the tensor contracts and causes a rotation of the manubrium, the following linear displacements of the umbo occur:

It is not surprising that observations through the external auditory meatus have remained negative and inconclusive on account of the minuteness of these displacements.

The definition of the strength of the stimulus is best given by sound-pressure measurements at the eardrum. However, at present a sound-pressure recording instrumentarium is not available but will be installed as soon as feasible. Only subjective definitions of the stimulus, classified as weak, medium strong, or strong, based on the loudness, are given. This seems adequate as long as the magnitude of the response is to be determined and no comparison between responses of the different persons is made.

The use of mirrors affixed to the eardrum is not difficult, not time-consuming, and, due to the simplicity of the system, is easily checked for and void of artefacts. However, while it is simple in an otological laboratory, it is still too complex for routine audiological tests. After the mirror experiments revealed the feasibility of the method and the magnitude of the signal, a clinically simpler method is being worked out at present. The mirror technique proved that the muscles do cause fine rotations of the hammer handle. It also proved that these movements are smaller than the direct observations through the outer ear canal would permit to visualize. The negative findings of previous observers (e. g., Waar) do not contradict our positive findings. In addition, the mirror experiments revealed that the acoustic rotations are substantially larger than the pulse and respiratory movements. The "signal-to-noise" ratio is favorable in this method. The order of magnitude was also established. With these findings available we are now in the process of utilizing instruments which record the magnified eardrum rotations outside the body.

The principle is that the instrument carries the minute motion of the eardrum through the external auditory canal by means of a water-filled tube. The membrane movements are then amplified at the external recording point by means of a sensitive, nearly frictionless, lever system. Then the resulting enlarged rotation is optically recorded.

The recording of the rotatory motion of the mirror on the outside is the same as that from the mirror on the eardrum. There is a beam of light shining on the mirror. When the mirror rotates, the light beam is deflected. The deflection can be recorded simultaneously with the acoustic signal. Thus, signal and tympanal reflex motion are recorded on the same screen. The two are photographed by 16 mm. motion-picture film, which also records the name or identification of the patient.

Besides this mechanic-magnetic system another acoustic probe working on the principle of a capacitance probe is being investigated as to its usefulness in routine tests.

## Summary

The contractions of the two intratympanic muscles are analyzed as to their usefulness as objective indicators of cochlear function.

Animal experiments demonstrating the quantitative relationship between sound stimulus and muscular response are quoted.

Observations made in patients through a perforation of the eardrum corroborate nearly all findings obtained in animal experiments.

Inasmuch as observations on the human are only possible if the perforation is suitable and the function of the cochlea, the reflex arc, and the mobility of the tendon is unimpaired, the number of observations is limited. The observation of the stapedius tendon, therefore, is not suitable for routine reflex studies. Following W. Köhler's experiments of 50 years ago, the attempt is being made to extend the observability of the reflex on all intact eardrums.

The contractions of the intratympanic muscles occur under isometric conditions (maximal change of tension under minimal displacement). Displacements are present but very small. Previous negative findings by direct observation do not contradict or rule out the existence of muscle contractions. Affixing of small mirrors on the eardrum provides a magnification of sufficient effectiveness to make the rotations of the malleus visible and to calculate the linear displacement.

Representative values which were found under acoustic stimulation are given.

Some examined persons were seen to give no reflex movements. The reason for this failure is not always clear. It is either due to an error in the method or due to an absence of the reflex. The clinical significance of an absent reflex of the tympanal muscles has not been ascertained as yet.

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# Clinical Determination of Abnormal Auditory Adaptation

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## Introduction

Hallpike and Hood[1] have clarified the necessity of distinguishing between the initial burst of auditory excitation, known as "on-effect," and the progressive reduction in excitation to continuous stimulation, which is called "adaptation." The normal hearing mechanism exhibits these two phenomena in a manner reminiscent of the neural events characterizing equilibration as observed by Derbyshire and Davis.[2] However, Hallpike and Hood turn to the work of Matthews[3] on the behavior of the stretch receptor for both the neurological analogy they accept and the concepts they develop.

These British workers have stimulated the clinician to reexamine both his theoretical orientation and his diagnostic practices by claiming that certain types of auditory pathology are characterized by an abnormal balance between "on-effect" and "adaptation." Hallpike and Hood have written that recruitment, which they claim distinguishes end-organ (cochlear) lesions from neural lesions, occurs because the "on-effect" is essentially normal. A tone which is strong enough to be heard therefore has marked loudness immediately after it is initiated. The authors point out that this is the situation in Ménière's disease, which they discuss as their prototype example of end-organ deafness. However, they also point to a provocative paradox, namely, that "adaptation" is abnormally rapid in Ménière's disease. In other words, a case suffering this type of end-organ involvement finds the loudness of a prolonged stimulus deteriorating with excess rapidity. Such abnormal adaptation is termed "relapse" by Hallpike and Hood. The simultaneous appearance of normal "on-effect" and "relapse" is to them phenomenologic of end-organ involvement. They say: ". . . we have to do with a *complex* of disordered hair cell function which is multipartite and of which loudness recruitment constitutes only one element." (Reference 1, p. 274.)

Hood[4] has suggested rather briefly that the "relapse" which characterized Ménière's disease can be demonstrated by observing deterioration to continuous stimulation at threshold level (1955). For example, he reports three cases of Ménière's disease whose thresholds for 2000 cps became markedly poorer when subjected to sustained stimulation at threshold. The phenomenon may be demonstrated either with an automatic audiometer of the Békésy type or with a conventional instrument. As regards the latter, Hood states:

> . . . the threshold of hearing [was] obtained in the conventional manner with an interrupted tone. After this was determined the intensity of the tone was raised by 5 db and applied continuously, the subject being asked to say when it could no longer be heard . . . In the subjects with end-organ disease, . . . after only five or six seconds of sustained stimulation, the sensation of tone had disappeared completely. After a rest period of one minute or more the procedure was repeated with the intensity of the tone raised successively by 5 db at each test. You will see that with higher tonal intensities the persistence of sensation becomes progressively longer until eventually an intensity is reached which evokes a sensation of tone indefinitely. This final intensity, however, is some 20 or 30 db above the [original] threshold . . . (Reference 4, pp. 514-515.)

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As would be expected, the phenomenon of auditory adaptation has been encountered for years by both research workers and clinicians. For example, Hirsh [5] (pp. 102-104) reports unpublished research by Rosenblith and Miller which demonstrates that the normal descending threshold for continuous tones may be several decibels poorer than the analogous ascending threshold, provided the descending sequence begins with a moderately intense tone. This finding is immediately meaningful when one remembers that a continuous tone which descends from a suprathreshold level will induce adaptation which an ascending stimulus does not incite.

Again, clinicians have often been plagued by manifestations of abnormal auditory adaptation. Unwitting excitation of abnormal adaptation, or "relapse," has undoubtedly accounted for many of the instances in which (1) pure-tone thresholds could not be determined with certainty because acuity fluctuated so greatly from moment to moment, (2) the comfortable listening level shifted as the patient heard a prolonged pure tone, and (3) uncertain results were obtained in loudness balance tests employing sustained stimuli.

Although "relapse" has been demonstrated as a phenomenon of Ménière's disease, there has been strong implication that it also characterizes other cochlear lesions. Hallpike and Hood in essence state that such is the case (Reference 1, p. 274). Again, as a by-product of other research, Jerger observed what we may now interpret as the separate functioning of "on-effect" and "relapse" in cases of acoustic trauma.[6] He was presenting 4000 cps for two minutes at a sensation level of 10 db. above the subject's threshold. Every 6 seconds he superimposed upon this stimulus a 0.5 second pip of the same frequency. The intensity increment of the pip was shifted from one run to another, the purpose being to measure the difference limen for intensity change by the quantal method. Astonishingly, some subjects with acoustic trauma reported that the sustained tone became unaudible, or "relapsed," before the two minutes had ended, yet the pips continued to be heard as easily even though they now rose out of silence. In other words, the difference limen for intensity change did not become poorer as the loudness of the background signal faded to nothingness. Stated differently, the pips continued to excite sharp "on-effects."

The observation of such phenomena disproves the belief, held by many clinicians, that there is a fixed relationship between loudness and the difference limen for intensity change. In some ears loudness is a highly unstable experience, depending as it does upon both the stimulus patterns of the instant and of the immediate past. Perception of intensity change does vary with psychophysical method,[7] but it is much less susceptible to the influences of prior stimulation.

For the clinician, one implication of this situation is the fact that the various difference limen tests are not *per se* tests for recruitment in a general sense. In all probability a difference limen test does measure the "on-effect" which can be excited in an ear. Furthermore, an impaired ear showing normal "on-effect" will yield a vigorous initial experience of loudness, which we can call recruitment. However, the fact that this perception will rapidly deteriorate in strength unless the stimulus is interrupted so as to excite the "on-effect" anew means that recruitment is a transient product of the "on-effect." We may, and we should, choose to define recruitment in this restricted fashion: namely, the abnormal loudness experience induced at the onset of stimulation. But we must avoid thinking that the abnormal loudness is an unvariable function of stimulus intensity.

The necessity to refine and modify certain clinical concepts does not in itself destroy the usefulness of the various procedures developed to isolate inner ear from retrocochlear lesions. It merely requires (1) proper understanding of the phenomenon being studied by a particular test, (2) choice of specific procedures suited to reveal the

phenomenon, and (3) description of the outcome in terms which are insightful and sufficiently restricted to avoid unwarranted generalization regarding the patient's practical auditory efficiency.

Contemporary clinical practice stresses tests which demonstrate whether or not an impaired ear has normal "on-effect." Most workers think of these tests as exploring for recruitment. Some of these methods purport to measure recruitment directly, while others are thought to do so indirectly. Notable among the latter are the various procedures for ascertaining the size of the intensity difference limen. Regardless of details in methodology, however, test results which can be interpreted as demonstrating recruitment are today commonly judged to be indications of end-organ lesion.

Paradoxically, although most workers are agreed on the significance they assign to recruitment, there is confusion and dissention regarding the practical value of contemporary tests. Direct demonstration of recruitment by loudness balance is possible only in the occasional clinical case. Indirect methods tend to be cumbersome and require special equipment. Moreover, indirect methods have sometimes been attacked as invalid.[8] In consequence of these several factors, we continue to need a simple method, which does not require additional apparatus, for segregating end-organ lesions from retrocochlear involvements.

A promising approach, which has not been employed as a concise clinical tool, would be to ascertain whether the impaired ear shows abnormal auditory adaptation to sustained stimulation. According to the thinking of Hood and his associates, such a condition of "relapse" is a second manifestation of hair-cell impairment. The immediate implication is that a simple test for abnormal adaptation would have as great diagnostic value as the so-called tests for recruitment. Such a test would be the preferable one if it proved easier to administer and were applicable to the widest range of patients.

## A Test for Auditory Adaptation at Threshold

With the aim of testing for auditory adaptation at threshold, a procedure known as the Threshold Tone Decay Test was developed in 1954 at Northwestern University. The original goal was to refine a technique which could be conducted rapidly in the typical office situation with any standard audiometer.

The plan of the tone decay test is simple. A sustained tone is presented to the subject at his threshold level. He signals, by keeping his finger raised, as long as he hears the tone. If he perceives the tone for a full minute he is judged to evidence no significant adaptation, and the exploration at that frequency is over. On the other hand, if he finds that the signal has faded into inaudibility before the minute is over, the stimulus is immediately increased 5 db. and a new minute of listening is begun. This process is continued until a level is found where the tone is heard without interruption for a full 60 seconds.* A record of the time is kept at each presentation level.

There are two major precautions which must be observed in administering the tone decay test.

First, the exploration must always be in the ascending direction. For this reason, it is important to have a previous audiogram which gives a general idea of threshold level. One should start with a sustained stimulus 10 to 15 db. weaker than this threshold level and then ascend in 5 db. steps until the subject responds.

Second, once the presentation of a test frequency has started there must never be an interruption in the stimulus while making audiometric adjustments. When a 5 db. increment is required, this increment is inserted by a rapid flick of the hearing loss

* An alternative is to set an arbitrary terminus, say the patient's 30 db. sensation level, above which the test is not continued even though the tone has not been perceived to the full 60 seconds. This alternative saves time in a few instances.

control on the audiometer. The added intensity will induce a single "on-effect," but there will not be any opportunity to recover from cumulative adaptation through rest.

The choice of frequencies to be employed in the tone decay test is an optional matter. It depends upon the audiometric configuration of the patient, the wishes of the examiner, and the time at his disposal. Experience suggests that an ample record is usually obtained by testing at octave intervals from 500 through 4000 cps. It is also occasionally desirable to include 250, 3000, or 8000 cps. Conversely, a useful picture is often obtained by testing either at only 500 and 4000 cps or at one frequency where acuity is normal and at those where it is impaired. Finally, each ear must be tested independently, since performance is not always bilaterally equivalent.

A chart has been developed to facilitate the reporting and interpretation of the Threshold Tone Decay Test. This chart allows a compact graphic summary of findings. It is illustrated in Figure 1. Note that stimulus intensity, expressed as hearing level re the audiometric norm, is indicated along the vertical scale as on the standard audiogram. By contrast with the audiogram, however, there is a separate column for each test frequency and the horizontal scale for each column represents the time, in seconds, during which the stimulus is heard.

The result of the test at a given frequency is plotted as a line connecting those points which represent the lengths of time during which successive presentation levels remain audible.

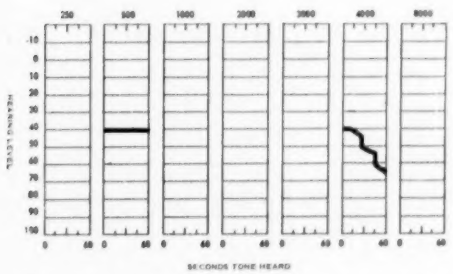


Fig. 1.—Chart used for graphing threshold tone decay, with plots illustrating no decay at 500 cps and appreciable decay at 4000 cps.

The two basic types of response which one encounters are illustrated in Figure 1. The heavy horizontal line at 40 db. in the column for 500 cps indicates that the tone was first heard at this presentation level and that, at this level, it persisted as an audible experience for a full minute. Note, by contrast, the irregular descending curve in the column for 4000 cps. The initial presentation at 40 db. was perceived for only 10 seconds. The tone continued to decay to inaudibility as the tonal intensity was increased in 5 db. steps. The decay appeared in 25 seconds at both the 45 and 50 db. levels, in 40 seconds at the 55 and 60 db. levels. It was not until the tone reached a level of 65 db., i. e., 25 db. above the subject's original threshold, that it satisfied the arbitrary criterion of persisting in awareness for a full minute.

### Clinical Variations in Adaptation

The outstanding fact which emerges when one administers the tone decay test clinically is that unexpected configurations and patterns of adaptation appear. It is still too early to judge the significance of every pattern. One can say that there are trends of performance which appear typical, but there are also bizarre response patterns which currently defy explanation. In consequence, it seems safe to make the statement that the tone decay test, as well as any other practical method for isolating auditory relapse, holds the key to a new precision in the differential diagnosis of sensorineural lesions of the hearing mechanism. As we learn how to interpret bizarre auditory adaptation, we may come to separate nonconductive pathologies which are indistinguishable from one another on the basis of today's conventional auditory tests.

The first step, of course, is to observe and to classify the adaptive phenomena exhibited by clinical cases. The breadth of the task is illustrated by contrasting the

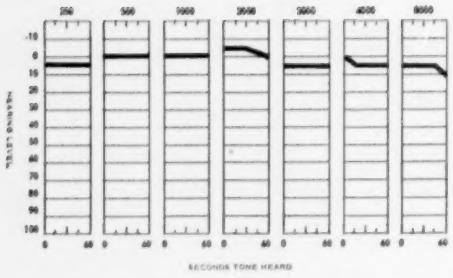

Fig. 2.—Response of a normal ear, illustrating absence of appreciable decay effect.

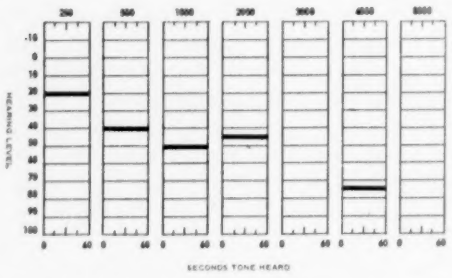

Fig. 3.—Response of an ear having sensorineural loss of unknown etiology, possibly congenital.

seven cases described below. The first case is a person with normal hearing. The next four cases were chosen because they represent patterns of response which have been commonly observed at the Northwestern University Hearing Clinic. These are reported without any presumption that they represent an exhaustive list. The last two cases are included because they illustrate the utterly unexpected and extreme adaptation which is sometimes encountered.

Figure 2 is typical of the Threshold Tone Decay Record yielded by a person with normal hearing.† Note that the stimulus is usually heard for the full minute at threshold and that this criterion is always satisfied at a level 5 db. above threshold. Such responses may be considered free from abnormal adaptation. The only additional point which need be stressed is the fact that the 60 second perception at threshold is commoner with stimuli of low frequency than with high-frequency stimuli. In the latter instances, subjects often require a sensation level of 5 db. to give the full reaction.

Some cases of sensorineural loss do not reveal appreciable tone decay at threshold. Figure 3 illustrates such a case. The figure summarizes the decay test results for the left ear of a 63-year-old man with bilateral sensorineural loss, etiology unknown, probably partially congenital. His difference limens for intensity change were sharply reduced from 1000 cps upward. Thus, the results suggest normal "on-effect" without associated "relapse."

As would be expected, failure to reveal appreciable tone decay is also found in sensorineural impairments where difference limens are not reduced, as well as in conductive losses. The foregoing case was used to illustrate the "nondecaying" type of test result because one would not here anticipate this result on *a priori* grounds. The case thus helps emphasize the need for systematic determination of the relationships which exist in the clinical population between "on-effect" (as indicated by DL measurements) and "relapse" (as indicated by threshold tone decay). Knowledge of these relationships will facilitate differential diagnosis.

Figure 4 shows the tone decay record for the right ear of a 77-year-old woman with bilaterally symmetrical sensorineural impairment of the presbycusic variety. It can be seen that there was only a slight tendency for decay to appear. This reaction is consistent with the observation that intensity DL's tend to be large in presbycusis and

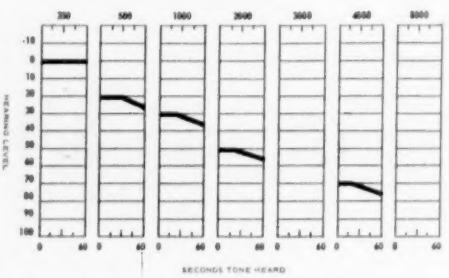

Fig. 4.—Response of an ear having sensorineural loss due to presbycusis.

† In the interests of simplicity, Figures 2 through 7 each graph the tone decay pattern for a single ear.

with the fact that degeneration of neural elements is often a major characteristic of auditory lesions in the elderly. However, one must be cautious in generalizing, since many patients classified as presbycusic evidence substantial tone decay.

Abnormal tone decay is the usual finding in cases of endolymphatic hydrops (Ménière's disease). However, the degree and pattern varies widely from case to case. Palva[9] reports a somewhat parallel situation at suprathreshold levels. One is led to the belief that the patient's pathological status at each moment is a strong determinant of the results which are obtained. A pattern of decay which is relatively typical of chronic hearing loss attributable to endolymphatic hydrops is reproduced in Figure 5. The interesting feature of the record is that abnormal adaptation persisting over a span of 20 db. or more took place with frequencies above 1000 cps.

The foregoing case also illustrates a situation which is so typical of the tone decay phenomenon that any deviation from it may be considered as highly noteworthy: namely, no tone decay was incited by stimuli of low frequency. In other words, when tone decay occurs there ordinarily is a division of response at some point on the frequency scale. Usually this point is around 1000 cps, where abnormal decay sometimes appears and sometimes does not. The same pattern is again exemplified, this time by the record of an otosclerotic ear showing both stapes fixation and secondary nerve degeneration, in Figure 6. Incidentally, it is interesting to recall that normal adaptation, as judged by responses at suprathreshold levels, is much more pronounced at frequencies from 1000 cps upward.[10]

Figure 6 reveals a further interesting fact. Once abnormal tone decay appears it does not always increase progressively as the test frequency is raised. The case shown here exhibited its most extreme decays at 1000 and 8000 cps, with less decay appearing at 2000 and 4000 cps. One might reason tentatively that extreme decay is related to active pathological conditions in the inner ear and that, when such a condition is spatially restricted in the organ of Corti, excess "relapse" is limited to frequencies whose reception is mediated by that particular cochlear region.

Speculation regarding this last possibility, and other possibilities as well, is given impetus by the fact that extreme and bizarre responses are sometimes evoked with the tone decay test. Consider, for example, the behavior yielded by a man of 47 possessing bilaterally symmetrical sensorineural deafness, etiology unknown. Figure 7 summarizes the responses for his right ear. Note first that his initial threshold responses were better for high frequencies than for low. In fact, standard audiometry revealed a loss of only 5 db. at 4000 cps. Observe second that a little tone decay was evident even at low test frequencies and that this decay increased progressively for the higher frequencies. Most importantly, notice the stupendous intensity span over which decay persisted at 4000 cps. The amount of decay

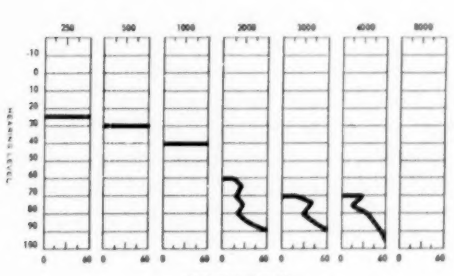


Fig. 5.—Response of an ear having sensorineural loss due to endolymphatic hydrops.

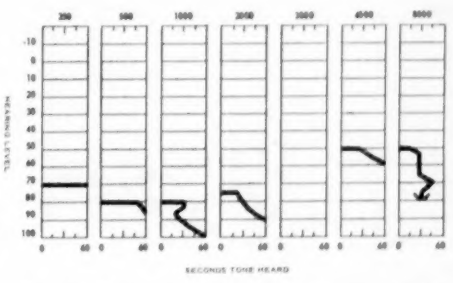


Fig. 6.—Response of an ear having otosclerosis characterized by stapes fixation and secondary nerve degeneration.

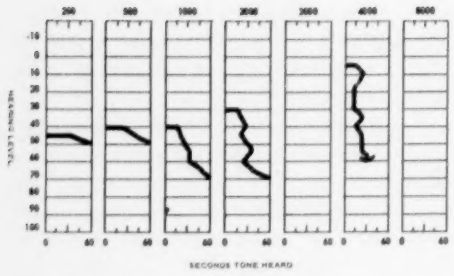

Fig. 7.—Response of an ear having sensorineural involvement of unknown etiology.

is in itself astonishing, but its appearance at a frequency where the initial threshold was normal is completely unexpected in terms of conventional concepts and methods of observation. One is faced with a paradox wherein at this frequency hearing is normal according to the standard criterion of acuity but highly abnormal according to the criterion of ability to sustain response to prolonged stimulation.

It is obviously too early to attempt an analysis of the implications which rise out of such paradoxes. We must first ascertain how frequently they occur and under what circumstances they appear. It is sufficient for the moment to emphasize that such paradoxes exist, and that the people who exhibit them may possess auditory pathologies which are currently going unrecognized.

To illustrate this last point, consider the case whose audiogram appears as Figure 8.

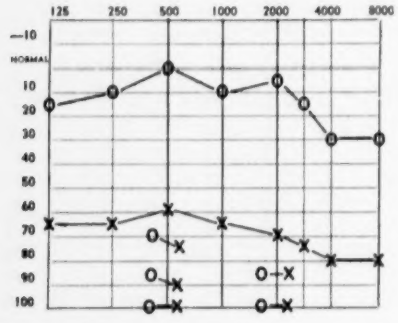


Fig. 8.—Air-conduction audiogram and loudness balance results yielded by a case with unilateral sensorineural loss, probably of toxic origin but cause indefinite.

If we consider only frequencies below 3000 cps, the right ear possessed essentially normal acuity, while the left showed a flat sensorineural loss of about 65 db. The case was diagnosed unilateral sensorineural loss, probably of toxic origin but cause indefinite. The left ear exhibited sharp recruitment as judged by loudness balance test (Fig. 8). It also revealed appreciable tone decay, as reported in Figure 9. Ordinarily, the tone decay test would not have been administered to the right ear, since it appeared clinically normal. However, threshold responses for this ear seemed a little unreliable. The tone decay test was consequently ordered. The

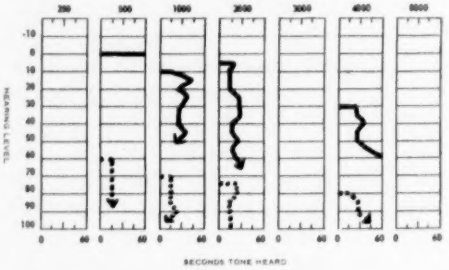

Fig. 9.—Response of the case shown in Figure 8 to the tone decay test, illustrating "relapse" in the presence of normal acuity. (Solid line is for the right ear, broken line for the left.)

results are also shown in Figure 9. Abnormal adaptation was exhibited by this ear at all frequencies, and at 2000 cps the effect was so extreme as almost to defy comment. Here decay was measured over an intensity span of 60 db., at which point the test was stopped. In other words, this ear yielded an "on-effect" at a hearing level of 5 db., yet prolonged stimulation induced so much "relapse" that temporarily the same stimulus at 65 db. was not perceived.

It would currently be hazardous to assume that all of the "relapse" exhibited by the foregoing case is of the peripheral variety described by Hallpike and Hood.[1] We must remember Kos [11] observed marked threshold shift in a case of acoustic neuroma and that he feels such decay is not an end-organ phenomenon. However, one thing is certain. The existence of occasional bizarre cases

combining normal acuity with abnormal auditory adaptation required that we reexamine clinical theory and reconsider the framework of diagnostic classification.

## Summary

The clinician will find it beneficial to differentiate between the "on-effect" which occurs at the outset of response to a stimulus and the auditory adaptation which appears when the stimulus is prolonged. Patients with end-organ deafness, according to Hood and his associates, reveal normal "on-effect" (which is responsible for loudness recruitment) but show "relapse" (which is adaptation of abnormal severity and rapidity).

The Threshold Tone Decay Test was designed as a simple means whereby the clinician might seek the phenomenon of "relapse." A pure tone is presented at threshold for a minute unless it fades into oblivion before that time. In the latter event the intensity is increased 5 db. No rest period is allowed. The procedure is repeated until the tone is heard at one level for a full 60 seconds, or until abnormal adaptation at threshold has been clearly demonstrated.

Clinical cases show varied configurations of response to the Threshold Tone Decay Test. Patterns tend to conform to theoretical expectation. However, there are instances (1) where the response varies markedly from one test frequency to the next, (2) where recruitment and "relapse," at threshold, seem disassociated, and (3) where extreme adaptation to sustained stimulation is evidenced by an ear with essentially normal threshold acuity. Therefore, the phenomenon of "relapse" seems to be sufficiently independent from auditory reactions which are currently measured, so that systematic study of this phenomenon can probably lead to classification of sensorineural involvements into new clinical subgroups.

Northwestern University.

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Case Reports

# Vestibular Paralysis and Cochlear Impairment Due to Streptomycin Intoxication

KURT TSCHIASSNY, M.D., and SANTO CERRI, M.D., Cincinnati

Streptomycin toxicity has been studied by many observers who reported disturbances arising from therapeutic use of the antibiotic. When streptomycin is administered in high dosage or over prolonged periods of time, toxic reactions involving the vestibular and sometimes also cochlear functions are regularly encountered. Hinshaw and Feldman (1945)[1] presented the first report. These authors observed one case of deafness and three cases with vestibular disturbances subsequent to large doses of streptomycin. They ascribed these symptoms to a selective toxic effect on the eighth cranial nerve.

The following year Brown and Hinshaw[2] reported similar observations in 23 cases during treatment with streptomycin. Disturbance of equilibrium with dizziness and lightheadedness appeared. The imbalance varied from gentle swaying to falling. The response to caloric stimulation and turning tests indicated a bilateral progressive decrease of vestibular function. In five patients they observed impairment of hearing when doses of 3 gm. a day or more were used. These authors did not determine whether the lesions involve the end-organ or supralabyrinthine structures.

Stevenson and co-workers[3] observed, at autopsy, pathological changes involving the ventral cochlear nuclei in five patients previously treated with large dosages of streptomycin. In two of them, involvement of the vestibular nuclei was seen.

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Farrington and co-workers[4] described identical lesions and stated also that vestibular symptoms appeared rather uniformly on the 21st day of treatment. Recovery depends on individual adaptation. Restoration of labyrinthine function was not observed.

Chase[5] performed audiometric studies on 150 patients before, during, and after treatment with streptomycin and found loss of vestibular response in 15 patients receiving 2 gm. of streptomycin daily for 90 days. In others with 1 gm. daily over the same period of time, there was less damage to the vestibular function, while 16 maintained a normal response throughout.

Hawkins and Mushett[6] produced ataxia and abolition of the vestibular response to rotation in rabbits, dogs, and cats by administration of streptomycin in high dosages.

Winston and co-workers,[7] experimenting on cats, found evidence of damage involving the vestibular nuclei. However, presence of a concomitant lesion of the end-organs could not be ruled out.

Tompsett[8] observed impairment of hearing and vestibular disturbance subsequent to administration of 1, 2, or 3 gm. of streptomycin a day over a period of six weeks.

Snell[9] presented a list of toxic manifestations resulting from streptomycin, including vertigo, tinnitus, impaired hearing, blurred vision, eosinophilia, perioral pruritus, dermatitis, angioneurotic edema, and albuminuria.

Fowler and Feind[10] noted that in 80% of 900 patients who received 1.8 to 2.0 gm. of streptomycin per day vertigo appeared in

the fourth week of treatment. After disappearance of vertigo, hypofunction or even absence of vestibular responses persisted. With 1 gm. of streptomycin per day, vestibular disturbances developed in 30% by the 60th day of treatment. This dose is the smallest in the literature to be followed by toxic sequelae. Auditory involvement not infrequently occurs when treatment is continued after appearance of vestibular deficiency.

Northington [11] found vestibular and cochlear dysfunction in 56 patients during the second week of a daily dose of 2.5 to 3.2 gm. of streptomycin.

Christensen and associates [12] noted degeneration in the vestibular ganglion and vestibular and cochlear nuclei and involvement of the Purkinje cells of guinea pigs treated with 100 to 400 mg. of streptomycin per kilogram daily.

Rüedi and co-workers [13] described changes in the area of the eighth-nerve nuclei, with apparently simultaneous degeneration in the vestibular end-organ. Far-advanced degeneration of the organ of Corti was seen, associated with pathological changes involving the stria vascularis, particularly in the basic turn.

Hawkins and associates [14] observed experimentally definite degeneration of the hair cells, with shrinking of the epithelium in the crista of the horizontal canals, and scattered degeneration of the hair cells in the macula of the utricle. The cochlea showed atrophy of the stria vascularis, pathological changes of the organ of Corti, with degeneration of the internal and external hair cells, and degenerative changes in the spiral ganglia. These authors stated that 1 gm. of streptomycin daily or only twice weekly gives therapeutic results comparable with those obtained with doses of 2 or 3 gm. daily. They reported also that preparations of increasingly high purity, together with introduction of the less toxic dihydrostreptomycin, brought about a striking reduction of toxic phenomena. Some hearing loss, however, is noticed when the drug is given in doses larger than 1 gm. daily for more than 120 days.

Heck and co-workers [15] stated that streptomycin is more likely to produce vestibular toxicity, while the toxic effect of dihydrostreptomycin shows cochlear preponderance. They also found that vestibular dysfunction became manifest soon (four weeks) after the streptomycin therapy was started. It appeared to be reversible on discontinuance of treatment, so long as not more than 1 gm. a day had been given for not more than 120 days.

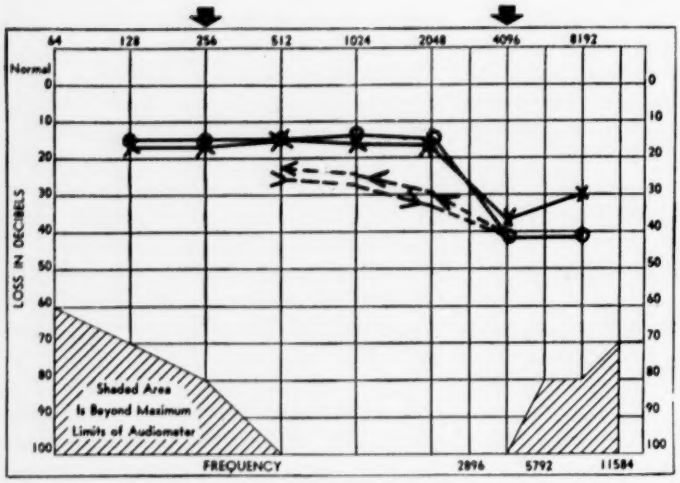
Streptomycin has been suggested by Floberg, Hamberger, and Hydén,[16] and more recently by Hanson,[17] in the treatment of Ménière's disease. These authors suggested the use of streptomycin for therapeutic destruction of the vestibular apparatus. They recommended 2 gm. daily for a period of four to six weeks, or 3 gm. divided in two daily doses for at least five days after the loss of cold-caloric response.

On the basis of these reports, one may conclude that toxic phenomena due to streptomycin appear, as a rule, after a dose exceeding 1 gm. a day for at least three to four weeks. A recent experience with a case demonstrating an unusually high degree of sensitivity to streptomycin provides an instructive contribution to the problem.

## Report of Case

A 67-year-old housewife was admitted to the hospital because of chronic cholecystitis and cholelithiasis in March, 1953. History and results of physical examination and routine blood and urine studies were not remarkable. Three days later, with the patient under endotracheal anesthesia, a cholecystectomy was performed without complications. Postoperative treatment included streptomycin, 1 gm. a day, divided into two doses. The postoperative course was uneventful. The patient was discharged after 22 days. No further streptomycin treatment was given.

After a few days, she felt imbalance, dizziness, sensation of lightness in the head, tinnitus, and disorientation when walking in the dark. These symptoms became progressively worse and frequent. Finally, the patient noticed some loss of hearing. She visited the clinic in March, 1956, i. e., almost three years after the operation. Results of examinations of the ears, nose, and throat




Audiogram of patient with complete vestibular paralysis and cochlear impairment after streptomycin therapy.

were not remarkable. Tuning-fork tests and audiometry showed perceptive type of hearing loss bilaterally, involving particularly 4000-8000 cps. Vestibular examination showed no spontaneous manifestations, except some undirectional imbalance in the Romberg position. There was no response on stopping rotation in either direction or on calorization of either ear with the use of abundant amounts of ice water. Two months later another examination was performed with identical results.

## Conclusion

A case is reported in which a small dosage of streptomycin had been given (0.5 gm. twice a day) over a period of 22 days, resulting in complete bilateral vestibular paralysis and damage to both cochleae involving the hearing for high frequencies. The lesion is still present after almost three years. Individual differences in susceptibility to streptomycin are known. However, we did not find a report indicating that a dosage of 1 gm. a day restricted to 22 days can cause complete vestibular destruction and partial involvement of cochlear function.

It may be mentioned that in the reported case abnormal renal function was not noticed. Persisting imbalance subsequent to bilateral loss of vestibular function in older persons is well known.

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# Skin-Graft Repair of Large Perforation After Fenestration

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## Introduction

Methods of repair of tympanic-membrane perforations is an interesting and much discussed subject. Repair of such perforations occurring in fenestrated ears is of utmost importance, since a perforation may nullify the hearing improvement of an otherwise very satisfactory procedure. A case in which the hearing improvement obtained from a successful fenestration was destroyed two years later by an otitis media which produced a massive perforation, later repaired successfully by a full-thickness skin graft, is herewith reported.

## Report of Case

A white woman, aged 45 years, was first seen in the office on Feb. 20, 1953, complaining of bilateral, progressive hearing loss of 17 to 18 years' duration. She had been socially inadequate, due to her deafness, for seven to eight years, and complained bitterly of head noises.

Past history revealed that she had had occasional earaches during childhood, extending on into adulthood, but had not had an earache in the past few years.

Physical examination was negative, and the Eustachian tubes were open. There was no excess of lymphoid tissue in the nasopharynx.

Tuning-fork tests and audiograms revealed a bilateral conductive hearing loss. Bone conduction averaged 8 db. loss on the left and 25 db. on the right, when corrected for the Carhart notch. Air conduction averaged 61 db. on the left and 65 db. on the right. Despite these findings, the patient considered her right ear to be her better ear, so that the left (Class A) ear was selected for fenestration.

On March 5, 1953, a fenestration operation was performed without incident by Lempert's cupola and invagination technique. Packs were removed on the 5th and 10th days as usual, and prophylactic penicillin was given for 5 days after surgery. The cavity was clean but slightly moist on March 24, 1953, and the patient was allowed to return to her home. She returned for occasional removal of crusts and debris from the cavity thereafter. Improvement to 30 db. in the speech frequencies from a postoperative level of 61 was accomplished.

Approximately two years later, the patient returned, on Feb. 28, 1955, with the history of a bad cold one month previously, followed by an earache in the ear operated on, and discharge persisting to the time of her return. Examination revealed a large, posterior-superior perforation of the tympanic membrane, bounded anteriorly by the handle of the malleus and posteriorly by the facial ridge and extending superiorly, and involving loss of most of the base of the fenestration flap as it stretches from the superior aspect of the drum, medially, superiorly, and posteriorly across the attic of the middle ear. Inferiorly, the drum had been destroyed well below the umbo, and the promontory was easily visible. Hearing had become entirely inadequate. Because of the great size of the perforation, and the inability of the patient to stay in the city for long periods of time, skin grafting of the perforation was recommended, rather than the long, drawn-out conservative method of closure by cautery.

On Feb. 22, 1956, under general endotracheal anesthesia, an elliptical incision was made behind the left ear and a full thickness of skin was removed, measuring roughly 1.5×1.5 cm. The graft was trimmed and thinned. An incision was made through the upper portion of the old endaural incision, and the wound was spread with the self-retaining mastoid retractor, exposing the cavity. The edges of the tympanic membrane bordering the perforation were freshened by removal of the edges with a small ear-biopsy forceps. The area superiorly was freshened by removing the tissue at the junction of the middle-ear mucosa and epithelized cavity with small cup forceps. With a myringotomy knife, an incision was made around the perimeter of the promontory, and it was then denuded by the use of the Lempert periosteal elevator and cup forceps. After bleeding had been controlled, the full-thickness graft, backed by sur-

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gical rayon to prevent disturbance of the graft when the packs were later removed, was placed over the perforation so that it overlapped all the freshened edges, and was firm against the denuded promontory. A small pledget of cotton was placed firmly into the concavity of the graft to maintain this contact with the promontory. On this was placed a small cellulose sponge, and the cavity was packed with petrolatum (Vaseline) gauze. The donor site, behind the pinna and the endaural incision, was closed with No. 3 black nonabsorbable surgical (silk) sutures, and a head dressing was applied.

Antibiotics were given prophylactically for the first five days. The patient left the hospital on the second postoperative day. The head dressing was removed on the fourth day, and the petrolatum-gauze packs and the cellulose sponge on the seventh day. The small cotton pledget and rayon were removed on the 11th day, and the graft appeared to be in place and healthy. Improvement in hearing to the preperforation levels has been attained and held. At the last examination, on May 18, 1956, the graft was firmly adhered to the promontory and well sealed peripherally, except posteriorly in the vicinity of the facial ridge, where a small dehiscence was seen. However, the cavity is entirely dry, and hearing has been restored.


### Summary

A case in which improvement in hearing obtained from a successful fenestration was destroyed two years later by an otitis media which produced a massive perforation, later repaired successfully by a full-thickness skin graft, with restoration of adequate hearing is reported.


705 Fifth Ave.

# News and Comment

## ANNOUNCEMENTS

**Scientific Exhibit of the American Medical Association Meeting.**—Applications for space in the Scientific Exhibit of the American Medical Association Annual Meeting in New York City next June 3-7, 1957, must be submitted before Dec. 17, 1956.

Anyone desiring to apply for space in the Section on Laryngology, Otology and Rhinology may secure an application blank from the Section Representative, Walter E. Heck, M.D., Stanford Hospital, San Francisco 15, or from the American Medical Association, 535 N. Dearborn St., Chicago 10.

**International Voice Conference.**—An International Voice Conference (Laryngeal Research, Function and Therapy) is to be held in Chicago from May 20 through May 22, 1957.

For information concerning the Conference write to Dr. Hans von Leden, 30 N. Michigan Ave., Chicago 2, Ill.

# An Unusual Complication of Otitis Media

*Extrusion of the Incus into the External Auditory Canal*

**FRED HARBERT, M.D., and HENRY H. SHERK, M.D., Philadelphia**

Extrusion of the incus into the external auditory canal as a complication of otitis media has not recently been described. The literature from 1945 to 1956 [1-3] was carefully reviewed and several texts [4-11] were consulted without this or a similar situation being noted. Degeneration and destruction of the ossicles by a purulent process in the middle ear is apparently not uncommon,[12-16] but only in several of the older texts [15,16] was the possibility of the extrusion of a nearly intact ossicle discussed.

## Report of Case

The patient, a 2-year-old Negro boy, first complained of pain and discharge in the right ear about a month prior to admission. The process subsided after several days, but within a week the patient began to complain of discomfort again and the sensation of a foreign body in his ear. His mother removed a small hard object from the right external canal, and when she first brought the child for treatment she presented this to the physicians in charge. It was recognized as the incus (Fig. 1). There was no evidence, however, of an acute process in either ear at that time, and examination of the right drum revealed a healing, granulating perforation at 11 o'clock in the pars tensa. Unfortunately, the patient left the hospital before treatment could be instituted, but several days later was brought in again with an acute otitis media on the left and was admitted on April 19, 1956.

Visualization of the left drum revealed a central perforation with injection of the drum. A minimal amount of exudate was noted. The right drum showed obliteration of all landmarks, but the drum was intact. No short process or handle of the malleus could be visualized. There was only dried exudate in the right ear. A turning reflex to a 512 fork to both sides was noted, indicating hearing in both ears. A smear and culture of the exudate from the left ear revealed many Gram-negative rods, which were shown to be Pseudomonas aeruginosa. A few hemolytic streptococci were also cultured. A blood cell count, urinalysis, and cerebrospinal-fluid examination were not unusual. An x-ray of the skull revealed only minimal haziness of cellular outlines on both sides.

Fig. 1.—Photograph of the incus.

The patient was treated with 200,000 units of penicillin and 250 mg. of streptomycin sulfate twice daily for eight days. The temperature returned to normal on the 2nd day, and, except for a spike to 100 F the 3rd day, remained normal throughout the 11 days of admission. He was discharged to the Ear, Nose, and Throat Clinic in apparent good health on April 30, 1956. The right ear remained the same as noted at the time of admission, and the left drum disclosed a healed central perforation. A description of the incus from the pathology laboratory read as follows:

"The specimen is fresh bone measuring 0.5×0.4×0.3 cm. Its inner configuration consists of three projections each measuring 0.3 cm. in length. Histological diagnosis: Degenerated bone tissue [Fig. 2]."

On follow-up examination on July 22, 1956, both drums appeared normal and were normally mobile. The child demonstrated no more than a 10 db.

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Fig. 2.—Photomicrograph of a histologic section of the incus; reduced 2/7 from mag. × 50.

hearing loss in the right ear when tested with a speech audiometer. The response to cold caloric stimulation as determined by the Dundas Grant method was within normal limits.

Jefferson Medical College Hospital.

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Progress in Otolaryngology

# The Paranasal Sinuses

*Summaries of the Bibliographic Material Available in the Field of Otolaryngology for 1954*

**SAMUEL SALINGER, M.D., Palm Springs, Calif.**

The material abstracted in this review comprises all of the references listed in the "Quarterly Cumulative Index Medicus" of the American Medical Association as well as those in the "Armed Forces Medical Library Catalog" for 1954. Compiling the lists of articles is a laborious task which takes considerable time. This accounts for the delay before they became available to the reviewer.

## Anatomy, Physiology

Negus [1] in a very extensive article replete with numerous illustrations describes the comparative anatomy of the nose and sinuses in animals and man. Much of the material has been presented in previous articles by the author, several of which were abstracted and appeared in this review. Sections through the skulls of a variety of mammals show the intricate formation of turbinals, recesses, and olfactory apparatus peculiar to each species and developed to different degrees according to their special needs. The illustrations showing cross sections in various animals are most instructive. It is amazing to view the intricate and complex formation of the ethmoturbinals, which furnish areas of wide expanse for olfaction as well as for heating and humidifying needs. The progressive diminution in their size and conformation is noted as one goes up in the scale of development through the higher mammals up to the human being.

This is a very scholarly piece of work and a valuable addition to our knowledge of nasal function.

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Negus [2] presents a very excellent study of the olfactory system in man and the lower animals. He shows how the olfactory sense is stimulated to perceive odors only after a sufficient number of molecules of the substance have been volatilized and carried to the olfactory mucosa at a certain degree of pressure. Keen-sensed animals have the advantage over humans in possessing a bony subethmoid shelf beneath the ethmoturbinals, which receives the impact of inspired particles but is protected against the expiratory current. Thus particles insufficient to stimulate the olfactory sense may accumulate until the next inspiration. Thus a larger number of molecules may finally reach an aggregate sufficient to stimulate the sense. In some cases the olfactory mucosa may extend into the frontal and sphenoidal recesses. In animals it has been shown how different portions of the special epithelium are sensitive to different types of odors. In the case of man, whose olfactory area is small and without recesses, it is difficult to explain how discrimination of odors is achieved.

The article is concise and well illustrated.

Negus [3] states that confusion and speculation relating to the function of the sinuses is the result of considering them as a whole. It is his conviction that the evolution of the air spaces individually has progressed in different lines and with different purposes. A study of various kinds of vertebrates reveals varying intranasal conformation depending on the needs of the particular species. When the sense of smell is so important for existence, one finds the

frontal sinus filled with ethmoturbinals to accommodate a wider expansion of the olfactory elements. To provide sufficient moisture for the solution of inhaled particles the maxilloturbinal may be enlarged to such a degree as to afford no space for the maxillary sinus. As the need for higher olfaction diminishes in the higher vertebrates and man, these organs become smaller, resulting in larger empty spaces, the sinuses. "The ethmoids result from fusion of the ecto-turbinals which have lost their olfactory function. Maxillary recesses and sinuses are unwanted air spaces resulting from disproportion between the size of the snout and the ethmoidal and maxillary turbinals contained therein. Their presence is useful as a source of a certain amount of moisture."

The article contains a number of interesting illustrations of cranial cross sections in certain animals.

Oltersdorf [4] states that increased pressure within a cell may well account for the development of a pyocele or a mucopyocele, but can hardly be accountable for the development of pneumatocele or mucocele. At operation many cases of mucocele fail to reveal any obstruction of the ostium, nor is the cavity always completely filled with fluid. Pneumatoceles have been observed in which the internal pressure may or may not be increased.

Several histologic specimens are shown in which the lining mucosa is hyperplastic and the surrounding bone manifests signs of activity with both osteoblasts and osteoclasts in evidence. The author believes that the cell expands through the endogenous growth stimulus arising from the hyperplastic mucosa acting upon the loose connective tissue. This process may be enhanced by long-acting exogenous stimuli.

Hyperplastic mucosa seems to resemble morphologically the early developmental stage of loose mesenchymal tissue. It is active and responds to external stimuli.

Maranon and Galvez Armengaud,[5] through a study of 365 radiographs of normal children between the age of 3 and 19, have been able to show the progressive development of the sphenoid sinuses. Having these norms at hand, one can readily determine any degree of underdevelopment and the age of arrest in cases where growth has been affected by such conditions as pituitary dwarfism, infantilism, myxedema of pituitary origin, and Mongolism. The degree of underdevelopment is generally parallel with the degree of the hypothalamopituitary insufficiency.

Bonnet [6] states that extension of the sphenoid sinus into the anterior clinoid process is not uncommon, being present in about 4% of all skulls. However, a prolongation into the posterior clinoid is quite rare. The author had failed to see 1 in 100 successive cadaver skulls. Recently he encountered one in a skull where the sphenoid sinuses were unusually extensive. In this case the sphenoid cavity extended into the posterior clinoid, which showed up in the x-rays quite ballooned out, its outline sharply demarcated by thin bone. Also in this case there was a prolongation into the lesser wings of the sphenoid. The outline of the internal carotid artery was plainly visible as two parallel lines.

The author states that prolongations of the sort described might easily explain the occurrence of an arachnoiditis in some cases of sphenoid infection.

Schlosshauer [7] discusses the pathogenesis of spongification of the frontal bone in the area usually occupied by the frontal sinus. This process differs from sclerosis with aplasia of the sinus, in that roentgenographically it simulates an opaque or densely clouded sinus with definite borders. It may come about through two different processes. In the one it is due to a failure in the normal pneumatization process, the mucosa failing to grow into the diploetic spaces which normally develop in the thick bone. One such was operated upon and revealed an area of dense sclerotic bone at the point where the nasofrontal duct would normally enter the sinus. In the other type the condition is the result of a long-standing infection in which new bone is formed to such a

degree as to obliterate the cavity. One case of this type is described.

Bertelli [8] describes two cases of direct communication between the frontal sinus and a pneumatized middle turbinate and two in which the orbitoethmoid cells showed a similar communication. Speculating on the cause of this anomaly, the author theorizes that it may be the result of a frontal sinus inflammation with residual absorption, apparently of unknown etiology, the process extending downward into the turbinal. Several illustrations show in diagram the communication between the pneumatized cavities. It is also demonstrated in x-ray pictures in which the cavities have been filled with a contrast medium.

Sestini [9] found among a series of cranial sections accumulated during the war one which showed an anomalous suture in the superior maxilla. It ran from the inferointernal angle of the orbit down to the bony nasal aperture through the frontal process of the bone, thus dividing the process into an external and an internal segment.

The author refers to reports of a similar finding by various observers in which some controversy has developed as to whether it is truly a suture line or a groove enclosing a blood vessel.

Mitchell [10] in a well-illustrated article describes the autonomic nerve system supplying the ear, nose, and throat. He points out several basic considerations, as follows:

1. The division of the nervous system into somatic and autonomic is artificial. They are neither separate nor distinct entities. "They originate from common primordial cells, they develop together, they are built up from the same basic neurons associated in similar reflex arcs, they comprise central and peripheral parts and, structurally, they are related and often closely connected."

2. The autonomic nervous system is not merely a peripheral afferent mechanism, for it is represented at every level of the nervous system. This explains why visceral and vascular disturbances may follow cerebral lesions and emotional upsets.

3. Parasympathetic preganglionic fibers originate from nuclei in the brain and form synapses with more than one neuron in peripheral ganglia near the structure innervated. Each fiber synapses with two or three ganglionic cells, thus differing from sympathetic fibers, which synapse with as many as 17 ganglionic neurons. This explains why parasympathetic effects are more limited than sympathetic, another reason being that the ganglionic neurons are shorter, whereas the sympathetic neurons are longer, since the ganglia are situated further away from the areas supplied.

4. Sympathetic activity produces vasoconstriction, parasympathetic vasodilation, and glandular secretion.

5. In general, innervation is segmental, the exception being the vagus and chorda tympani, which cross segmental barriers.

6. Recent theories that certain chemicals act as mediators in the transmission of nerve impulses across synapses and between efferent nerve endings and the structures they supply are impressive but presuppose the existence of definite nerve endings with junctioned zones, proof of which is still lacking.

The author produces illustrations showing a fine reticulum of nerve fibrillae surrounding a small arteriole and spread out in the submucous tissue of the pharynx. Some believe that there is a syncitial continuity between the nerve fibrillae and the protoplasm of the effector cells. "Others believe that the terminal reticulae are really formed by the interlacing processes of small interstitial nerve cells intervening between the terminations of the efferent fibers and the effector visceral cells." This theory is doubted by others.

The author describes in detail the origin, ramification, and distribution of the autonomic fibers throughout the otolaryngologic field, with illustrations that are clear and graphic.

Much of his material is credited to research conducted in the Department of Anatomy, Manchester University.

The article is comprehensive and informative and must be read in full.

Scott [11] shows a number of skull sections of lower animals depicting the complex structure of the turbinates, and compares their function with that of the simpler turbinals of man. Since the air-conditioning function of the nasal mucosa can be performed through the less extensive surface in the human nose, it is assumed that the turbinates are concerned with another function, namely, regulation of body temperature "by acting as a moist vascular surface at which heat loss can occur by the physical processes of convection and vaporization." Thus the degree of heat loss through the mucosa depends on vascularity, moisture, and area of the membrane. In the human being the skin is a more efficient heat-regulating mechanism than in lower animals. Thus, there is less need for complex turbinal structure. Control or correlation between the mucous membrane and the skin in this function depends on the activity of the autonomic nervous system and the ductless glands.

Cole [12] continued his investigation of temperature recordings of inspired and exhaled air by means of a "thermistor resistance element coupled through a resistance bridge network and a D. C. amplifier to a C. R. O. tube. Temperature changes which alter the electrical resistance of the thermistor element were recorded photographically from the C. R. O. tube." Recordings were made from various localities all the way from the anterior nares and oral aperture down to the trachea. Also, the observations were made under varying room conditions, such as cold storage chamber, Turkish baths, day atmosphere, and steam room. Also recordings were made under different atmospheric pressures from sea level to decompression chamber up to 35,000 ft.

The conclusions reached after a study of all these recordings were as follows:

"Most of the conditioning occurs before the air reaches the trachea. It continues to approach body temperature as it passes from the pharynx towards the lungs.

"During mouth breathing inspiratory air is less effectively conditioned at pharyngeal level than during nasal breathing; but the differences decrease and are very small in the trachea.

"When thermal demands are great as with high ventilation rates or in cold environments, conditioning of inspiratory air extends more deeply into the respiratory tract.

"During expiration heat and water are returned to the mucosa along the whole of the respiratory tract, mainly near the portal of exit.

"The body loses more heat and water during oral than during nasal breathing.

"Expiratory air condition as it leaves the body is independent of ventilation rate.

"Atmospheric pressure-changes corresponding to heights of up to 35,000 feet has little effect upon respiratory air condition.

"The determinations made under various climatic conditions confirm the results of earlier work by the present writer, in which an entirely different technique was employed."

### Pathology, Diagnosis

Stoksted,[13] who has done considerable research in the field of nasal respiration, has an article dealing with the effect of nasal obstruction on pulmonary ventilation. More specifically, he is concerned with the question as to how much nasal obstruction must be present before mouth breathing takes over. Thirty patients with various degrees of nasal obstruction were subjected to manometric determinations of the nasal air pressure. He found that the degree of air pressure was no indication as to how soon the person would have to resort to mouth breathing. The values were extremely variable. He reasons that when nasal obstruction is chronic the $CO_2$ percentage of the lungs is stabilized at a higher level than normal and the respiratory center responds with a different type of respiratory rate, whereby the ventilation of the lungs and

the oxygen absorption is maintained. This factor is extremely variable because of the variable degrees of concentration which different persons will tolerate. Consequently the point at which mouth breathing takes over is variable, and therefore the degree of nasal obstruction is no index.

Wolf [14] calls attention to the influence of the autonomic nervous system on the nasal mucosa in response to emotion and stress. He cites several cases in which marked nasal obstruction and headache were observed during the recital of a conflicting domestic situation, the symptoms disappearing when the stress was relieved. Biopsy specimens showed edema of the stroma, dilated vessels, and overactive mucous glands. He attributes this hyperactivity of the mucosa to increased cholinergic stimuli. Pathologic changes may result from such prolonged stimuli.

Eickhoff [15] studied the histopathologic changes in the nerves of sinus mucosa in cases of suppurative and polypoid infections by means of the Bielschowsky silver stain. These changes are similar to those observed in inflammatory processes elsewhere as reported by various authors, and cannot be considered as characteristic of sinus disease. They show various degenerative changes, such as increase in the agranophiles, swelling and constriction of individual fibrils and vacuoles, and breaking-up and disintegration of some fibers.

Serfling [16] investigated the influence of unilateral choanal atresia on the sinuses and middle ear in seven patients ranging in age from 9 to 36 years. He found that in no instance were the sinuses on the occluded side any less developed than on the open side. Apparently a choanal atresia does not interfere with normal pneumatization. However, in two of the cases there were other evidences of maldevelopment such as cleft lip and inner-ear deafness.

Sinus infection was demonstrated in three of the patients and affected the patent side as frequently as the occluded side. The author feels definitely that the abnormal conditions created by the obstruction must in a considerable proportion of the cases lead to infection.

Research studies by Sala [17] on guinea pigs to determine the comparative reactive capabilities of skin and mucous membrane failed to demonstrate any marked difference, except that the reactions developed earlier in the mucosa. The experiments consisted of injecting cod liver oil into the subcutaneous and submucosal tissues and then observing the granulomas that resulted.

Berdal [18] in a very extensive monograph attempted to answer the question as to whether nasal polypi are an expression of an allergic process, by investigating the serologic changes in the polyp fluid and comparing the results with those obtained by examining blood serum and experimentally induced blisters. When a specific allergen penetrates into an allergic mucosa producing an allergic inflammation, it is assumed that there will be an influx of antibodies. The investigation attempts to discover whether there is any correlation between serological changes in the polyp fluid and histological nature of the polyps, as well as its clinical features.

The investigations were carried out in 36 patients chosen from patients with polyps who had reacted to one or more reagins through intradermal testing.

To determine the content of skin-sensitizing antibodies contained in polyp fluid, the latter, having been expressed from the polyps, was employed in passive transfer inoculation according to the method of Prausnitz-Kuster-deBesche. The results were compared with reactions obtained by inoculations with the patient's serum and fluid obtained from cantharides blisters. It was found that the polyp fluid showed a higher content of reagins than serum, blister fluid, or nasal secretions. Further experiments neutralizing the reagins in vivo by passive transfer and reinjection of homologous antigen showed a neutralization of the reagins had taken place by the first antigen injection.

Considerable space is given to description of the histology of polyps as well as their

clinical features. Eosinophilic determination locally as well as in the blood stream brought out no significant points except that there was no correlation between the number of eosinophiles in the blood and the content of reagins in the polyp fluid.

The conclusion that may be drawn from the study is that accumulation of reagins in polyp fluid compared with that in serum shows that sensitization to certain allergens had taken place in the mucosa. Taken together with the typically allergic type of inflammation found in the polyp area, this tends to support the thesis that polypi are the result of local sensitization.

The case histories are submitted in detail; also a description of the testing procedure and analysis of the numerous findings.

Halla [19] describes a small, battery-contained transilluminator for diagnosing frontal and maxillary sinusitis, which he states will often save the patient the expense of x-ray pictures. From the illustration it does not appear to differ much from the transilluminators commonly used in these parts, and it is difficult for the reviewer to recognize any superiority which would eliminate the necessity for x-ray pictures.

Blümlein [20] shows several beautiful x-ray pictures and diagrams illustrating the projections he prefers for the sinuses. They include the typical Waters position, the straight P-A, and the nose-chin with open mouth. Commenting on the use of contrast media, he names all the substances in vogue and suggests the lighter concentrations in aqueous solutions of iodides, barium, and thorium. Also he strongly advises against the use of radioactive thorium, citing several cases of malignancy developing after a period of years.

Boenninghaus [21] describes the "overtilted" axial projection for the frontal sinuses, discussing its advantages over the conventional projections in several illustrative cases. This position projects the frontal sinuses into the space of the open mouth so that the anterior and posterior walls appear separately as though viewed from below. Thus pathology involving either may be seen without having to eliminate any overlying bony shadows. Also the depth of the sinus at the floor is clearly shown. The value of this projection is illustrated in a case where aplasia was in question, a case of thickening of one wall due to previous infection, direct apposition of the two walls of a shallow sinus from long-standing infection, and a case where one sinus was obliterated by surgery, showing the complete collapse of the soft tissues against the posterior wall.

Portmann and Guillen [22] have found axial and horizontal tomography of great value in the diagnosis of tumors of the paranasal sinuses. While some of the lines are not as clear as might be desired because of blurring due to opacities of adjacent tissues, much valuable information is still obtainable, particularly for tumors of the invasive type. Several examples are shown with accompanying diagrams which point out the anatomic landmarks and the regions invaded by the growths.

The authors express the hope that further radiological research may improve the technique.

Schoger [23] refers to previous reports by Schulz (*Medizinische Klinik* 46:1039, 1951) and Teitge (*Medizinische Klinik* 46:772 and 1040, 1951) on the value of routine fluoroscopy of the sinuses, which is done when chest x-rays are taken. He claims that many cases of symptomless sinusitis are brought to light in this manner. The author has followed this procedure in 1500 cases and found 145 that showed positive evidence of sinus abnormality. These cases were then x-rayed, and in 94 (65%) the findings corroborated the fluoroscopic evidence. Most of these patients had no typical sinus complaints, but it was evident that the sinuses were the foci of infection, particularly in a series of rheumatic cases which the author was investigating.

Bethmann [24] describes an endoscope which he uses to inspect the interior of the antrum. It has a trocar, cannula, and scope with distal illumination, very similar to a nasopharyngoscope. One may puncture the sinus

either through the canine fossa or the inferior meatus. Also it may be passed through an antrostomy opening to observe the cavity during the healing process. He shows quite a few pictures of various pathologic states and discusses the evaluation of the visual image in terms of color variations and topographical irregularities. Also the light reflexes are of some significance.

Gerke [25] demonstrates the errors that may arise in the interpretation of x-ray films purporting to show the relationship of the roots of teeth to the floor of the antrum. These errors are due to the angle at which the rays strike the film. He calls it the half angle (approximately 45 degrees), and in the drawing shown one can see that the malar projection often casts a shadow which obscures the floor of the antrum. The author contends that a truer picture can be obtained by having the rays projected through the alveolus at right angles to the film. The latter, instead of being placed diagonally against the palate, alveolus, and teeth, should be fixed in the perpendicular plane, and this can be accomplished by interposing a cotton roll between the film and the teeth. The illustrations show the floor of the antrum sharply delineated in correct relationship to the roots of the teeth.

This article of Ge.ke [26] is more detailed than the one just cited, presenting numerous examples of anatomic and pathologic aberrations. He shows the extreme variability in the relationship of teeth to antrum floor resulting from differences in the extent of the alveolar extension of the sinus and the varying thickness of its floor. A number of excellent x-ray pictures depicting all sorts of pathologic entities makes this a very instructive paper. He shows here, as in the other presentation, how the x-ray picture may be misleading. A piece of wire laid along the floor of the alveolar recess shows up in the picture at a different level than the bony line. Because of the difficulty in interpreting the x-ray pictures it is important that various projections be employed, bearing in mind the avoiding of confusing overlying bony masses and the necessity for getting the central ray properly lined up through the suspected area and the film.

Tridon and Pasquet [27] present a rather extensive review of the known data pertaining to the relationship of the apices of the tooth roots to the floor of the antrum. They show how the antral floor dips down, bringing it into the region of the second premolar and the first molar. According to most authorities, the second molar is the one most frequently in close approximation to the antral floor. Naturally the danger of infection being transmitted from one to the other is greater the closer the approximation. After discussing the lesions which are responsible for sinus involvement of dental origin, such as apical granuloma, apical cyst, dental abscess, pyorrhea, and displaced tooth roots, the authors proceed to a description of their roentgenographic technique for diagnosis. They favor the occlusal film, or "dysocclusole," as they term it, with transorbital or subzygomatic projection. The principal ray is directed at an angle somewhat less than 90 degrees, varying from 8 to 15 degrees according to the inclination of the various teeth. These projections avoid the overlying shadow of the malar bone, which can be very confusing. As a matter of fact, to be thorough an x-ray examination has to include retroalveolar and ortho-occlusal projections as well as extrabuccal of the entire maxilla and at times the planigraphs. Inadequate knowledge due to poor or incomplete techniques may cost the patient the loss of healthy teeth as well as an unnecessary sinus operation.

According to Weyand and Camp,[28] meningiomas arising from the tuberculum sella or the olfactory groove produce changes in the bone which can be detected by careful roentgenography. Hyperostoses and erosion are the common findings and were present in 33 out of 51 meningiomas of the tuberculum sellae and in 25 out of 42 cases arising from the olfactory groove. As a rule these changes occur at the point of origin of the growth and therefore afford excellent landmarks for surgery. The authors recommend

stereoscopic lateral projections, with one view a direct lateral and the other a view with the tube shifted in the coronal plane. Also the Towne and Granger projections are useful for demonstrating the anterior portion of the roof of the sphenoid sinus.

Helm [29] presents a series of photographs showing the position of the head in relation to the Giantureo apparatus for the various projections in x-ray of the sinuses and mastoids. Each projection shown is accompanied by the resulting roentgenogram. The apparatus is quite simple, permitting all the pictures to be taken with the patient sitting and apparently comfortable. The x-ray pictures are all excellent and can well serve as models.

Bollobas [30] demonstrates a new trocar and cannula with attachment for viewing the interior of the antrum with an endoscope. He uses a Brunnings loop for magnifying the image. The author claims that it is possible to do a biopsy through his cannula, whose caliber is only 4 mm. Diagrams show the assembly, and photographs show the instrument in place and the picture of polypoid mucosa as seen through the scope. He mentions having used it to good advantage in 39 cases and describes the various types of pathology encountered.

Gillain and Doyen [31] have successfully employed Muhlenkamp's method of instilling potassium permanganate (1%) into the maxillary sinus in 50 cases for diagnosis. The whole point in the procedure lies in the fact that if the solution comes in contact with pus it becomes discolored. If the sinus is normal the fluid returns unchanged. The results in allergic cases, however, are not dependable. At times the solution remains unchanged; at others it is altered. Mucus apparently fails to mix with the solution and therefore fails to affect it. The authors note, however, that in cases where the sinus fails to expel the fluid within the average normal period of time, it comes out discolored. This is taken to confirm a diagnosis of chronic hyperplastic sinusitis, which would also be indicated by the delay in the expulsion of the solution.

## Intracranial Complications: Ocular and Orbital Complications

A case of meningoencephalitis following an acute frontal sinusitis reported by Hohlbrugger [32] appeared to resolve following the administration of 6,000,000 units of penicillin and 20 grains (1.2 gm.) of epinephrine (Supranol). Jacksonian seizures, hemiparesis, motor and sensory aphasia, photophobia, and spinal-fluid findings all indicated a focal lesion. However, certain factors seemed to point against the presence of an abscess, namely, the absence of a high leukocytosis, the suddenness of the onset, and the diversity of the symptoms. The author feels that edema, possibly on an allergic basis, may have been a factor.

Pichler [33] reports a case of encephalomyelitis disseminata in a 24-year-old woman which was attributed to a focus of infection in the sinuses. The case was complicated by a history of skull trauma at birth with resulting facial paralysis and a second cranial injury at the age of 18. It was assumed that these injuries caused a severe cerebral shock and probably some contusion. Examination revealed a markedly hyperergic person, and, under the circumstances, it was decided to first treat her with antibiotics and antihistaminics. She was given large doses of penicillin, vasodilators, vitamin B complex and ascorbic acid (vitamin C), liver extracts, and antihistaminics. The sinuses were then irrigated and the deviated septum was resected, resulting in relief from the headaches. She was kept under neurologic control under the same therapy and showed marked subjective improvement.

Citing a number of references, the author stresses the factor of allergy in the pathogenesis of disseminated encephalomyelitis.

Sambataro [34] tells about a boy of 14 who, at the age of 8, was kicked by a horse, sustaining the trauma over the supraorbital region. He was unconscious for 24 hours but recovered within 10 days without any sequelae except a scar over the brow. A year and a half later, during an upper respiratory episode, he developed severe headache, vomiting, and neck rigidity, but

recovered without therapy within a short time. A year later he had another flare-up, this time due to a cold and another blow over the forehead. Under penicillin therapy and a lumbar puncture the symptoms abated. A fourth flare-up of the same nature brought him to the clinic. Examination revealed neck rigidity, a positive Kernig's sign, a tender irregular cicatrix at the outer third of the brow, and x-ray findings pointing to infection in the corresponding frontal sinus. At operation a fissure was found in the supraorbital ridge through which, on pressure, cerebrospinal fluid exuded. The frontal sinus was full of pus. After it and the ethmoids were cleaned out the fracture line was demonstrated in the extreme external portion of the cavity with a thin plate of bone about the point from which the fluid was coming. The dura was exposed, presenting a typical pachymeningitis with granulations through which the fluid was escaping. The area was covered with powdered antibiotics and a hemostatic absorbable gelatin sponge, and the cavity drained via the enlarged frontal duct. Under antibiotic therapy the lad made an uneventful recovery.

The interesting features of this case were the absence of x-ray findings of the fracture (which did not run through the posterior wall but gave rise to symptoms such as are usually associated with this condition), the unusual location of the fracture, and the repeated episodes of meningeal symptoms.

The moral is quite clear.

The case of a woman of 49 who was treated for a severe sinusitis with resolution of all local symptoms about a month previous is reported by Gerest, Rouves, Boucher, and Robert.[35] However, the temperature remained elevated, and with recurrence of headache a lumbar puncture was done, with negative findings. Shortly thereafter Jacksonian seizures were experienced, increasing in frequency. When admitted to the hospital she was almost comatose, had a temperature of 41 C (105.8 F), and was having seizures. There was a facial paresis (left), brachial monoplegia (right), but no Babinski, no neck rigidity, and no papillary edema. A diagnosis of cerebral thrombophlebitis was made, and it was assumed that the infection was transmitted from the previously diseased sinus. Electroencephalography revealed alterations in the right frontotemporal zone. X-rays of the sinuses were negative. Under antibiotic therapy the monoplegia disappeared but the facial paralysis persisted. Subsequent electroencephalogram still showed a slight irregularity in rhythm, but the focal signs had disappeared. Anticoagulants were not employed in this case, although in another case they were considered necessary.

Hager[36] reported a case of meningitis following a frontobasilar fracture in a man of 60, in which recovery followed under the administration of antibiotics and chemotherapy. He states, however, that such cases need to be watched carefully, since any signs of recurrence would be indication for prompt surgery. Discussing this presentation, Dr. E. H. Mayer emphasized the danger of serious sequelae in cases thus treated, citing several authors on this point. It is still better in cases of fracture with dural laceration to expose the area and seal off the laceration.

Novotny pointed out that it is often difficult to determine at once whether there is a traumatic communication between the arachnoid space and the nose. If pulsation is seen within the nose, the indication is clear. However, in case of doubt, the antibiotics offer a reliable deterrent against infection for the time being or until the picture becomes clearer.

Williamson-Noble[37] discusses the various types of orbital involvement due to sinus infection. He describes the anatomic relationship of the structures adjacent to the orbit which predispose to and facilitate the spread of infection. Infection is transmitted either by direct invasion through the intervening bony wall or via dehiscences which are frequently present, or by way of anastomosing thrombosed veins or from remote areas by metastasis. Inflammatory diseases of the

orbit are due to sinusitis in at least 70% of the cases. It is important to bear this in mind when confronted with a case of edema of a lid often suggesting an abscess which is not present. The author quotes Duke-Elder that "a harmful exploratory incision is made while all the time the lesion causing the reaction and determining the associated systemic symptoms is suppuration in a nasal sinus." This is particularly pertinent in children, where the general condition belies the apparent seriousness of the orbital or palpebral edema.

Subperiosteal abscess is accompanied by pain and tenderness. Cellulitis of the orbit causes proptosis, fixation, chemosis, and often symptoms of phlebitis which may spread to the cavernous sinus. The symptoms and signs are well known to ophthalmologists, and incision and drainage may be necessary when antibiotic therapy and attention to the primary infection in the sinus fail to halt the process.

The author calls attention to chronic inflammatory pseudotumors of the orbit due to sinus infection, a condition that frequently is misdiagnosed as an orbital tumor or malignant growth. In some of these cases the eye has been unnecessarily sacrificed. The contents of the orbit in such a case was described as a lymphatic hyperplasia. It is suggested that the sinuses be carefully investigated and treated in such cases, and therapy in the form of iodides and mercury be given over a period of months.

Heimendinger, Klotz, and Lafon [38] report a case in which the only symptom of an osteoma of the frontal sinus was a progressive loss of vision due to papillary edema. X-rays revealed the tumor at the base of the frontal sinus close to the intersinus septum, which was readily removed through the usual brow incision. The authors were at a loss to explain the connection between the growth and the optic nerve involvement, since neither infection nor disturbance of anatomic features was present. About the only tenable theory that might answer the question is the possibility of a vascular distortion due to pressure on the trigeminosympathetic nerves.

Alba [39] presents several interesting cases of orbital complications due to nasal and sinus pathology. One was a mucocele presenting through the floor of the frontal sinus. The tumefaction was also visible in the middle meatus, from which tissue was removed for biopsy, releasing a quantity of fluid. X-rays then showed that the mass was bilocular, which was then confirmed by further surgery via the transantral route. The second case was also a mucocele which became infected and ruptured, leaving a draining fistula. The third case of frontoethmoid mucocele was operated on via an external incision, and the resulting cavity filled with abdominal fat. X-rays taken a year and a half later showed the frontal sinus completely obliterated. The author finds the Bárány technique most favorable for these cases.

A case of meningoencephalocele in a child of 3 is shown, the tumor presenting at the superointernal angle of the orbit. The diagnosis was suspected because of the absence of frontal sinuses. The mass was aspirated and iodized oil (Lipiodol) injected, revealing a hydroencephalocele, which was successfully removed.

Another interesting case was in a woman of 20 who had had a mucocele removed five years ago and recently presented a mass in the medial portion of the upper lid. It was aspirated and filled with iodized oil, which revealed a cyst. When operated on it was found to be adherent to the scar of the previous operation. Since the tissue on histologic examination showed an abundance of sebaceous glands it was diagnosed as a congenital cyst of the orbit.

A lad of 7 developed a swelling of the cheek in a period of a month, associated with edema of the lids and slight exophthalmos. X-rays showed a dark antrum. Puncture lavage released a quantity of fluid. The sinus was opened at the same time that a tonsillectomy was performed and was found to be filled with a gelatinous hemorrhagic

fluid. The histologic diagnosis was hyperplasia angiomatosa.

A case of pneumocele of the antrum which at first looked like a mucocele was diagnosed by puncture and iodized oil. This case also had produced a mild degree of exophthalmos.

A child of 5 developed exophthalmos during the course of an acute upper respiratory infection. Within a week the vision in both eyes was gone and there was a bilateral ophthalmoplegia with edema of both the lids. X-rays showed the nasal chambers completely filled with a dense mass which on biopsy showed only round cells, the exact nature of which could not be explained. The child died in 45 days. Surgery had been denied.

The final case was a cylindroma of the ethmoid, proved on biopsy and treated by irradiation, since the family objected to surgery which would involve enucleation of the orbit.

A case of acute bilateral exophthalmos complicating a pansinusitis, cited by Thiébaut and associates,[40] leads to a discussion as to whether the patient had a cavernous sinus thrombophlebitis or not. Severe headaches and facial pains at the onset were followed by fixation of the head, tenderness over the masseter and temporomaxillary joint, and then palpebral edema and exophthalmos. Spinal tap revealed 0.4% albumin and 20 lymphocytes. X-rays showed bilateral clouding of all the sinuses. Transantral ethmosphenoidectomies were performed, yielding pus and polypoid mucosa. With ample antibiotic medication the patient recovered.

The authors submit that there were three syndromes in this case, namely: (1) the local sinus infection, predominantly sphenoethmoidal on one side and maxillary on the other; (2) general systemic infection with signs of meningitis or meningoencephalitis, and (3) the orbital syndrome. Thrombophlebitis was ruled out because the extraocular muscles were not involved and the fundi were unaffected. However, there is no doubt that the contributory veins, such as the pterygomaxillary plexus and the ophthalmic veins, were involved. There is no doubt that the antibiotics played a major role in the recovery, supporting the surgical procedures.

Lemoyne[41] had a rough time with an asthmatic patient following a transantral ethmoidectomy under general anesthesia. Despite a low blood pressure and normal coagulation and bleeding time, hemorrhage was so severe as to require bilateral ethmoid packing. A postnasal pack had to be introduced in addition. The patient developed a marked hematoma of the upper lid, signs of orbital cellulitis, and loss of vision on the fifth day. Despite vigorous antibiotic therapy and several transfusions a meningitis developed with a cell count of 700 and an enterococcus on culture. Eventually the patient recovered although the one eye remained blind.

The author interprets the succession of distressing phenomena as the result of several factors operating simultaneously, viz., a vasomotor instability, low blood pressure produced by a ganglioplegia, and orbital hematoma causing pressure on the retinal artery. The late appearance of meningitis was attributed to retrograde infection via the veins.

Weisbaum's[42] case was in a boy of 12 who presented a severe swelling of the left eye of less than 30 hours' duration, and visual impairment. It was further elicited from the father that 10 days previously the child had complained of a foreign-body sensation lasting only a day or two. Examination revealed a marked edema of the lids, tenderness over the frontal and ethmoids, and x-ray findings indicating infection of the frontal, ethmoids, and antrum. An external ethmoidectomy revealed pus. The antrum was also drained. Cultures obtained showed Corynebacterium acnes similar to diphtheroid and sensitive to various antibiotics. He was put on heavy doses of erythromycin, and although the sinus infection cleared up the optic neuritis progressed to complete atrophy. A few months later the child developed similar symptoms in the opposite eye, but fortunately the optic symp-

toms receded following an external ethmoidectomy.

Pohlman,[43] in a symposium on exophthalmos, contributes a short résumé of the nasal conditions which may be the inciting factor. These may be inflammatory or neoplastic, the former being commoner in children, the latter in adults. Infection of the orbit in infants arises from the ethmoids and can easily penetrate the thin lamina papyracea. In older persons the frontal sinus may be the source of the infection. The pathology may be a simple edema, a subperiosteal abscess, an osteitis, or a thrombophlebitis, any of which may cause an orbital cellulitis or abscess, causing displacement of the bulb.

Of the tumors that may invade the orbit causing exophthalmos, mucoceles are the commonest of benign type, with osteomas less frequent. Malignancies arising in the antrum or ethmoids, either carcinoma or sarcoma, if not discovered early inevitably spread to the orbit, causing marked displacement of the bulb.

Plisnier and Coppez,[44] citing several authors, recognize five stages in the development of orbital complications due to ethmofrontal infection as follows: (*a*) simple palpebral edema; (*b*) periostitis with suppuration, painful orbital swelling, and limitation of ocular movements; (*c*) orbital abscess with chemosis and exophthalmos, impaired ocular mobility, and impaired vision; (*d*) same as (*c*) plus phlebitis of orbital veins, and (*e*) same as above with involvement of the cavernous sinus and extension to the opposite eye. Extension to the cranial cavity is also discussed in its various manifestations. A number of illustrative cases are discussed, with appropriate x-ray pictures and drawings indicating the location of the spreading infection.

The lesson that they have learned is that many cases of orbital involvement may be anticipated and diagnosed early through close observation by both ophthalmologist and rhinologist. Thickening of the floor of the frontal sinus, with or without pain, and recurring pain and swelling at the internal angle of the orbit are significant signs. The authors have found planigraphy very helpful in outlining diseased areas. They recommend a procedure described by Van den Branden for radical care, as one which prevents secondary closure of the nasofrontal passage. In this operation a large nasofrontal canal is created by removing considerable bone from the frontal process of the superior maxilla, the orbital rim, the frontal spine, and some of the supraorbital border, in addition to exenterating the anterior ethmoid cells. The passage thus created forms a wide trough descending vertically rather than posteriorly at an angle, and is kept open by means of a rubber tube left in place for four weeks. They claim that this technique avoids disturbing the pulley of the oblique and the lacrimal sac.

Lallemant and associates[45] had a case in a man of 33 who, following a grippal attack, manifested bilateral ocular disturbances along with headaches and nasal discharge. A slight papillary edema was frequent without much damage to the vision or visual fields. The symptoms disappeared in a few days under medical treatment. Three months later the visual disturbance reappeared; also the headaches and discharge. Conservative therapy failed to improve the patient. At this time they found a large eccentric bilateral central scotoma and contraction of the temporal fields and loss of color vision. It was diagnosed as optic chiasm arachnoiditis. X-ray pictures revealed no pathology, except that the Hirtz projector showed a shadow in the ethmoids on one side with apparent absorption of bony trabeculae. A transantral ethmoidectomy was performed. The antrum was normal except for a small encysted pus sac near the floor of the nasoantral wall. The ethmoids contained small fungoid masses, the mucosal lining was thickened, and a dehiscence was found, the shape of a 50 centime piece, in the roof at the junction of the middle and posterior third. The exposed dura seemed normal. Under antibiotic therapy the patient gradually recovered his visual acuity, being normal in one eye and slightly less than normal in the other.

The authors comment on the prompt recovery following surgery, despite the minimal findings. They attribute it to the freeing of the vascular pathways, through which the infection was transmitted to the chiasmal arachnoid.

### Osteomyelitis

Johnson [46] reports three unusual cases of osteomyelitis of the frontal bone of rhinogenic origin. In the first case a 13-year-old boy with a history of recent trauma and an upper respiratory infection developed an osteomyelitis with subsequent signs of intracranial pressure but no evidence of an abscess. Despite extensive removal of diseased bone the process continued unabated to the death of the patient. Autopsy revealed a malignant glioma of both frontal lobes, previously unsuspected because of repeated negative neurologic and neurosurgical investigation. The second case was associated with an extensive extradural abscess. Hemolytic coagulate-positive Staphylococcus aureus was found on culture, and the patient recovered following wide removal of diseased bone, drainage, and oxytetracycline (Terramycin) and streptomycin sulfate therapy. In the third case the osteomyelitis was complicated by an extradural abscess and a deep cerebral abscess with pus between the frontal lobes. The offending organism was an anerobic nonhemolytic Streptococcus sensitive to penicillin and streptomycin.

The author concludes from a study of these cases that the classic edema associated by Mosher with osteomyelitis is not always present. X-ray evidence is always late in appearing. If a walled-off extradural abscess is present, the margins may well represent the extent of the overlying osteomyelitis. In the absence of such limitation the bony process is likely to be more widespread and is an indication for more extensive ablation.

Harrison [47] has had good results from surgery of the frontal bone in cases of osteomyelitis, employing the coronal incision for the exposure. In acute cases, the antibiotics alone may obviate the necessity for surgery. Operation is indicated if the condition deteriorates despite the antibiotics and other conservative measures.

In subacute cases the chances of a cure through conservative therapy are much less than in acute cases, and in chronic cases the outlook is still less favorable. Temporary respite may be obtained, but the danger of smoldering foci lighting up is too great to justify temporizing. In all these cases, the wide exposure afforded by the coronal incision makes it possible to inspect the entire frontal region and to properly excise all the diseased tissue, even down into the ethmoids.

Six cases of varying degrees are cited in which the above procedure was followed with excellent results.

Lederer [48] cured a case of acute osteomyelitis following an attack of grippe, without resorting to surgery. There was extensive edema of the forehead and face, fluctuation over the frontal bones, and x-ray evidence of bone absorption. Pus was recovered from the frontal sinus by irrigation. The subperiosteal abscess was aspirated, removing 15 cc. of pus, following which 400,000 units of penicillin was instilled. Penicillin and sulfonamides were administered two to three times a day, and the sinuses were irrigated several times, followed by penicillin. After 14 days the frontal swelling had disappeared. The bony defect previously present could now be palpated, showing rough bony margins. At this time the area was filled with 400,000 units of depot penicillin, which was repeated twice. On the 21st day the patient was symptom-free, the sinus wash clear, and there were evidences of beginning bony regeneration. Medication was suspended. Twenty-four hours later there was pain and renewed swelling of the forehead. The area was aspirated, yielding 10 cc. of pus. Penicillin was again instilled; also into the sinus and penicillin I. M. and sulfonamides administered. All the symptoms subsided, but medication was continued for another 10 days. There were no further recurrences, and the patient was apparently

normal when seen two and a half years later.

### Bronchopulmonary Complications Sinusitis in Children

Anglesio and Redoglia [49] present the case histories of 20 patients with sinobronchitis, with a discussion of the pathogenesis and general clinical features. The long list of symptoms includes chronic irritating persistent morning cough, nasal discharge, asthma, nasal voice, facial pallor, headaches, loss of appetite, occasional fever, sweating of the hands and feet, etc. The onset is never very clear; generally it can be traced back to some acute respiratory episode or series of attacks, since which time the patient has been aware of a state of inadequacy.

The discussion of the pathogenesis leads the authors to the conclusion that a constitutional inferiority of the entire respiratory mucosa plus an allergic tendency are the basic predisposing factors. In this connection they see a resemblance between sinobronchitis and Kartagener's syndrome and fibrocystic pancreatitis, in both of which conditions there is an association between bronchopulmonary disease and abnormalities in the sinuses.

Errecart and associates,[50] in a lengthy dissertation on the subject of rhinobronchitis, discuss the many factors which come into play: physiologic, congenital, bacteriologic, neurologic, allergic, etc. Any one or a combination of several of these may determine whether the upper respiratory passages are incapable of adequately dealing with infection. They quote Flurin's classification of rhinobronchitis in three groups, namely, those that are the result of nasal obstruction, those that are caused by reflex action originating in the nasopharynx, and those which are the result of a descending infection. Instability of the autonomic nervous system, acquired sensitivity to certain bacteria, and an inherited tendency to allergy are the commonest factors. These are all discussed in detail, and the final conclusion as to therapy, which is quite obvious, depends on the proper evaluation of these factors.

Caux and Moreau [51] discuss the question of the relationship between sinusitis and bronchiectasis, and come to the conclusion that there is a definite association, because in some cases proper treatment of the sinus infection has been followed by cessation of the bronchial symptoms. They cite several cases in young adults where ethmoidectomy and Caldwell-Luc yielded excellent results, the patients remaining symptom-free for several years. Bronchial aspiration and aerosol therapy were employed at the same time. In only one of the six cases cited was a lobectomy considered necessary.

The authors emphasize the importance of thorough investigation of the sinuses in all cases of bronchiectasis.

Thorough investigation of 28 familie comprising 63 persons by Prigal [52] revealed 17 in which there was definite evidence of contagion and a carrier state. The high incidence of sinusitis and recurring respiratory infections in this group would seem to support the thesis that the persistence of infection in these families is due to the harboring of pathogenic bacteria. The hemolytic Streptococcus was frequently encountered, and although temporary remissions with bacteria-free cultures could be obtained under specific antibiotic therapy, recurrences were common. It was found that infections of the eye and skin in certain members of a family served as foci of infection for many of the rest. Careful hygienic measures are necessary in order to eliminate these continuing sources of infection by carriers. In some cases autogenous vaccines may be helpful in building up immunity.

Brown [53] marshals a long list of references to support his thesis that adenoidectomy is not only unnecessary in most cases but actually harmful. The only true indication he admits to is complete occlusion of the nasopharynx by the mass. In most cases mouth breathing is not due to the adenoids but rather to intranasal conditions, including

chronic sinusitis. He contends that the adenoids rarely harbor infection in the same manner as the tonsils, because of the difference in their structure, such as lack of deep tortuous crypts and absence of enveloping capsule. Also he denies that the adenoids contribute to otitic disease, again citing Lemere, Kaiser, and others.

The author claims that the adenoids act as a barrier to the descent of infection to the lower respiratory tract, and claims that their removal only increases the hazard of lower respiratory infections. Throughout the entire article there is frequent repetition of the statement that chronic sinusitis is common among children and accounts for much of the symptomatology ascribed to the adenoids.

The article is based on a study conducted at the Pediatric Chest Clinic, New York Post Graduate Medical School and Hospital.

Routine x-ray pictures of the sinuses in a series of 300 children showed 50% to be normal, according to Wessolowski, Tiling, and Bergmann.[54] The remainder showed cloudiness of varying degrees, and these were then punctured and irrigated; 85 cases yielded pus or infective bacteria in the fluid. These were treated by repeated irrigation and instillation of antibiotics. Where indicated the tonsils and adenoids were removed.

The authors discuss the role of such infections in bronchopulmonary disease, referring to the Anglo-American "sinobronchitis," an entity which they recognize and have observed in their series.

They believe the infected antrum can act as a focus for disturbances of the vegetative nervous system, and call attention to such manifestations as convulsive seizures, restlessness, inability to concentrate, and general atony. Also they have noted alterations in the EKG of many patients and cardiac irregularities, which they attribute to the toxic effects of the sinus focus.

Many of these cases require general constitutional therapy and watchful care over a period of months.

After a short clinical résumé of the now rarely seen acute necrotizing ethmoiditis, Kartagener's triad, sinusitis in association with cystic pancreatitis, and sinusitis following swimming, Rüedi [55] takes up at great length the question of occult sinusitis in children. The diagnosis is made on the basis of x-ray findings and exploratory irrigations. He points out the importance of taking x-rays of the sinuses in all cases where the chest is examined because of bronchopulmonary symptoms. It is also important that this be done in many cases where the tonsils and adenoids seem to be the only cause of the patient's symptoms. Only in this manner can many cases of symptomless sinusitis be uncovered. When the infection is limited to the antrums, therapy should consist of irrigations (preferably through the middle meatus), vasoconstrictors at home with the patient held in the Proetz or Parkinson position, antihistamines orally if indicated, and antibiotics parenterally. Seldom is surgery necessary. Attention to constitutional disabilities is very important, which includes diet, hygiene, etc. These measures are even more urgent in cases of pansinusitis, where, in addition to the above-mentioned procedures, x-ray therapy may be of benefit. These cases are very trying and require utmost patience and understanding. Removal of tonsils and adenoids is helpful but constitutes only one aspect of the over-all therapy.

Sauter [56] has found latent hyperplastic sinusitis quite common in children between the ages of 4 and 12. In many cases it appears to be the residuum of a previous unresolved infection. Good x-ray pictures are extremely important in the diagnosis because the symptoms are few and not characteristic. He cites several cases to show the variety of conditions which may be the result of a latent sinusitis. One was a case of a postsinus pulmonary syndrome which cleared up following proper drainage and local therapy. Another was a case of scarlet fever without a rash in conjunction with a sinusitis; also a case of purpura rheumatica with decided improvement following

therapy to the infected sinus. Finally he cited a case of glomerulonephritis which apparently was due to an infection in the antrum.

The author claims that these instances could be multiplied if greater care were given to the examination and investigation of the sinuses in all cases where a focus of infection is suspected.

Considering the problem of chronic maxillary sinusitis in children, Maspetiol and associates [57] did biopsies in 22 cases with the following results: The mucosa was atrophic in three, granulomatous in three, hypertrophic in eight, and intermediary in eight. Since the majority were in the latter two categories they concluded that the reactions were mainly of the edematous type. Of particular interest was the absence of suppuration and the absence of eosinophiles. They believe that these conditions are peculiar to that stage of life when lymphatic elements are particularly abundant and the neurovegetative system unstable. The authors rule out allergy in most cases because of the absence of a family history, other stigmata of allergy, and the absence of eosinophiles. Therefore, they are forced to conclude that the etiology is a nonspecific hypersensitivity peculiar to this age. In support of this thesis they point out the histologic findings, namely, vasodilatations, increased capillary permeability, and edema. The tissues respond to minor irritations which provoke reactions in the neurovegetative system. The factors inciting such reactions may be physical, chemical, or biological.

González Loza [58] considers it well worth while to take x-ray pictures of the sinuses in infants and young children presenting nasal symptoms. While the procedure is usually not easy, it can be successful if the child is given some secobarbital (Seconal) prior to the exposures. He shows a number of pictures taken at various ages from a six-month fetus to puberty. One difficulty arises from the superimposed shadows of tooth buds obscuring the antrums. In a 6-month-old infant pneumatization can barely be seen, but by the end of the first year it is far enough advanced so that differences in the two sides can be detected and may be of considerable value in determining the presence of infection.

Goodyear [59] advises instillation of chloriodized oil (Iodochlorol) into the antrums of children suffering from chronic sinusitis associated with long-standing bronchial cough. In most cases it can be done under local anesthesia via a fine cannula introduced through the normal ostium. One or two injections at an interval of 7 to 10 days relieves the cough in most cases.

In addition, he prescribes Calcidin * tablets (2.5 grains [0.15 gm.]) plus 0.5 grain (30 mg.) of thyroid extract once a day before breakfast for a period of 10 to 14 days. More resistant cases are subjected to an intranasal antrostomy.

Goodyear feels that every rhinologist should have his own x-ray apparatus with a proper head unit to facilitate diagnosis and follow-up examinations.

Tonsils and adenoids should be removed when indicated and the iodized oil injected into the antrums at the same time.

The author recommends checking the status of the sinus following oil instillation by x-ray pictures with contrast medium about two weeks after the last treatment. Filling defects in some cases may indicate long-standing hyperplasia and would be an indication for the antrostomy as mentioned above. He refers to his publication in the ARCHIVES OF OTOLARYNGOLOGY (50:795 [Dec.] 1949) in which the details are more elaborately spelled out.

### Malignant Tumors

Larsson and Mårtensson [60] submit a report covering a period of 10 years (1940-1950) during which 379 cases of malignancy of the nasal sinuses were observed. These are analyzed from the point of view of symptomatology, histopathology, therapy, and results. Of these patients, 334 were accepted for study and possible therapy. The symp-

* Compound of iodine with lime and starch, plus calcium iodate with 15% available iodine.

toms were listed under two headings, "initial" and "total," as follows:

| | Initial | Total |
|---|---|---|
| Pain | 25% | 51% |
| Purulent discharge | 20% | 43% |
| Nasal obstruction | 18% | 38% |
| Oral symptoms | 15% | 26% |
| Swelling cheek | 12% | 43% |
| Nasal bleeding | 8.5% | 30% |
| Ocular symptoms | 5% | 23% |

The vast majority were squamous-cell carcinoma (216 out of 334).

Contraindications to surgery were extreme old age with poor general condition or intercurrent complications; x-ray evidence of destruction of the cranial base or pterygoid process; marked extension into the soft tissues, especially the mucosa of the nasopharynx; generalized metastases or inoperable lymph nodes.

Their best results were obtained through combined x-ray therapy and radical excision with surgical diathermy. Cases thus treated from 1940 to 1947, numbering 114, yielded 45% five-year cures.

In a group of 14 cases in which metastases to the regional nodes were present and treated by radical neck dissection, there were 10 which could be followed for five years. Five of these were apparently symptom-free.

At the present time their procedure is to have every case reviewed by the rhinologist and the radiologist after a study of the microscopic biopsy specimens and the local examination for a decision as to its operability. All cases of antrum carcinoma are examined thoroughly via a Caldwell-Luc exposure. Cases considered operable are then given a course of x-ray treatment in divided doses over a period of four to six weeks, after which the area is radically exenterated. Radium is then inserted into the operative defect. If lymph nodes are present they are also irradiated prior to excision.

Marks [61] reports two cases of carcinoma of the antrum treated only by irradiation who survived beyond five years without recurrence.

The first was in a woman of 65 with a history of recurring polypi with malignant degeneration as proved by biopsy via a Caldwell-Luc. She was given four courses of deep x-ray, each consisting of 10 treatments through various portals for a total of 9200 r. No recurrence after five years.

The other was a woman of 29 with a growth on the alveolus diagnosed by biopsy as a spindle-cell sarcoma. X-rays showed destruction of the floor of the antrum. Treatment consisted in the application of radon capsules filtered by 4 mm. of lead imbedded in a wax mold "in the confines of the palpable and visible tumor." The mold was left in place for five days, being removed daily for cleansing. The total dose was 19,600 mc-hr. No recurrence after 20 years.

Mattick and Streuter [62] present an analysis of 68 cases of carcinoma of the antrum observed at the Roswell Park Memorial Institute over a period of 10 years. Cases arising in the adjacent areas, such as the palate, alveolus, nares, etc., were not included, nor were malignancies other than those of epithelial origin.

Regional node metastases were present in 25%, which is considered a sign of advanced disease. Also the authors noted that when the x-rays showed involvement of the bone the prognosis was bad; likewise, extension to the orbit, nose, oral cavity, ethmoids, and cheek.

Treatment consisted of radiation combined with conservative surgery. More recently surgery has been more extensive with electrodesiccation and intracavity radium followed by deep x-rays. The over-all recovery rate, including the unfavorable cases, was 15%, whereas in the early and favorable group the recoveries reached 35%.

Spinal-meningeal metastasis from malignancy of the sinuses is very rare, according to Plaut,[63] who describes such a case in detail. Although the early complaint of pressure behind the eye and severe headaches suggested pathology at the base of the brain, the x-rays of the sinuses failed to

disclose any abnormality. It was not until the case had progressed to the point where the neurologic findings were so numerous that it became clear he was dealing with an extensive growth originating in the pons, growing along the base and involving a number of cranial nerves. The affected eye was enucleated, revealing the malignant tissue filling the orbit and extending into the antrum through an opening in the floor. X-ray therapy was ineffectual. Autopsy showed involvement of the entire base of the skull and invasion of the meninges, spreading inside the spinal dura and through the canals and nerve roots as far down as the cauda.

Terracol and Camps [64] present an extensive article on the subject of malignant granuloma in which the theories of pathogenesis, histopathology, clinical and therapeutic data are gone into in great detail. They also include a complete list of all cases previously reported in the literature with short abstracts in each instance.

The case which they themselves report is followed through from beginning to end with numerous reports of the progressive blood changes and histologic aberrations.

The authors do not approve of the term "malignant granuloma," claiming that pathologists are not agreed on the findings even from the same case. They prefer terming it "conjunctival malignant tumor" or "malignant reticulo-endotheliosis." Their findings reveal a wide variety of cells of the mesenchymal type, such as monocytes, reticulohistocytes, as well as plasmocytes, macrophages, and polynuclear leukocytes.

The list of publications in their bibliography is divided into three periods. They credit Wood in 1921 as being the first to use the term "malignant granuloma," although the first reported case was seen by MacBride in 1896. The histopathogenesis assumed by various authors includes "allergic origin," "malignant reticulosis," "mycosis fungoides," "malignant tumor formation," "inflammatory or infectious origin," and "indeterminate."

The article is of value chiefly from the historical point of view because of the vast amount of literature covered, although, of course, the basic question is not solved, namely, the true nature of the malady.

Alexander [65] reports two cases of lethal granuloma of the nose and face, both in women, which ended in the death of the patients. In one case, considerable relief was obtained from cortisone and corticotropin (ACTH), although the progress of the disease was not halted. In the second case the course was more rapid. In neither case did any of the antibiotics seem to have any effect.

Popper [66] had a case of malignant granuloma of the upper jaw in a 37-year-old woman. When first seen by the author she already had a perforation in the hard palate and a foul discharge from the area. The lesion involved the ethmoids as well as the antrum. Histologically the biopsy specimen revealed masses of round cells which were neither lymphocytes nor neutrophiles. There were no mitoses, and the cells were growing along the cross fibers of the musculature. They were uniformly small with round nuclei, rich in chromatin, somewhat similar to those seen in lymph nodes or, at times, somewhat larger with less chromatin, resembling reticulum cells. Roentgen therapy (4000 r) seemed to arrest the growth after extensive sequestration had taken place. However, the author's experience in another case leads him to believe that the remission was only temporary.

Schwartz [67] summarizes in abstract the record of 91 cases of plasmocytoma culled from the literature, adding 2 of his own. He discusses the relationship of plasmocytoma to multiple myeloma, which is a plasmocytoid tumor. The diagnosis of the latter is not always possible, at least until the lesions become disseminated. A solitary plasmocytoma of the upper air passages, especially if it invades the bone, may be indistinguishable from a metastatic myeloma. The author considers plasmocytoma as a localized malignant growth which begins in the mucosa and

may remain latent for months or years. Eventually it may become generalized. The average survival period after dissemination (two years or less) is the same as in multiple myeloma. Tumors in the soft tissues have a longer expectancy than those originating in the bone.

One of the two cases reported was in a man of 49 whose nasal destruction was due to a mass in the nasopharynx originating in the posterior choana. It was surgically removed. Histologically it revealed large nests of plasmocytes, also lipoid-bearing cells. X-ray therapy was given to shrink the residual nodules in the pharynx. The eventual outcome was not noted.

The other case was in a 48-year-old man with dural discharge and a red mass occluding the canal. It was removed via an endaural approach. The histologic appearance on section was characteristic. The further course of the case was not given.

### Benign Tumors

Warthin's tumor (papillary cystadenoma) is characterized by cystic spaces, pseudostratified columnar epithelium lining the spaces, arrangement of nuclei presenting the appearance of a double nuclear row, subepithelial stroma of lymphoid tissue, and irregular papillary folding of stroma and epithelium into the cystic spaces. Most frequently the growth is found in the region of the parotid gland, although cases have been reported located in other regions of the neck.

The case reported by Struthers, Williams, and Parkhill [68] was in a 69-year-old woman, whose complaint was recurring unilateral nasal hemorrhage. Biopsy of a polypoid mass in the nose was done and found to consist of pseudostratified columnar cells in irregular folds and polypoid arrangement. A Caldwell-Luc operation was performed. The sinus was filled with a dense tumor mass attached to the mesial wall and extending into the ethmoid. The histologic pattern conformed to the classic description of Warthin's tumor except for a paucity of lymphoid stroma.

The authors claim this is the first report of a case of this kind in this location, so far as they have been able to discover.

Lederer [69] reports an interesting case of an expanding fibroma originating in the posterior ethmoids, growing into the antrum, and eroding through the alveolar process into the mouth. The bulb was displaced, but mobility and vision were unimpaired. Biopsy revealed fibroma, but, because of the extent of the growth, the possibility of sarcoma could not be ruled out. The patient was therefore given 10,400 r of irradiation, which failed to reduce the mass. It was removed via a Denker approach. It proved to be a true fibroma which had undergone cystic degeneration and had displaced the orbital wall and posterior wall of the antrum without, however, causing any destruction of the bone, which was intact, though thinned out. The exophthalmos receded slowly from a maximum of 6 mm. to 1.5 mm. during a period of seven months. The pictures of histologic sections show typical fibrous tissue with some polymorphosis and irregular nuclear formation.

Schwab [70] cites a rare case of true fibroma of the frontal sinus in a 48-year-old woman. The history was of a slowly growing mass displacing the bulb with only a vague sensation of pressure. X-rays showed a large frontal sinus with ill-defined cloudiness. The mass was exposed through a supraorbital incision and was readily removed. It was rather firm and well defined, attached to the anterior wall and extending to the posterior wall, which was eroded for a couple of centimeters, exposing the dura. Recovery was uneventful. Two illustrations show the typical histology of a fibroma.

Peimer [71] reports three cases of giant-cell tumor involving the maxillary sinus, the sphenoids and ethmoids, and the roof of the orbit. In only the first case was it possible to completely excise the tumor, which originated in the anterior wall of the antrum and eroded through the canine fossa. The sec-

ond case showed extensive involvement of the sphenoid bone with erosion of the floor of the pituitary fossa and extending into the posterior nares. This case received radiotherapy, which was only moderately effective. The mass appeared to be slightly increased in size at the end of 18 months. The third case involved the frontoethmoid region and roof of the orbit. It was exposed through an incision along the orbital rim. Tumor tissue was found above and behind the bulb. A dehiscence was present in the orbital roof behind the frontal sinus, exposing the dura. The frontal and ethmoids were cleaned out, and the patient was given a course of radiation therapy. Twenty months after surgery it was reported that the patient was well, although the eye was still proptosed.

The author discusses the etiology of the disorder, citing several authorities. It is apparent that there is still some controversy between those who believe it is due to abnormal hyperplasia of osteoclasts left at a site of enchondral ossification and those who think that it is a definite neoplasm arising from the undifferentiated supporting connective tissue of the marrow.

Jensen,[72] citing a case of eosinophilic granuloma of the frontal bone, outlines the chief characteristics of this entity. It attacks the cranial bones in 35% of all cases and is found mostly in males at an early age. It appears as an elastic tumor in the bone, without periosteal reaction and with minimal redness of the overlying skin. X-ray pictures will show a circumscribed area of bone absorption fairly well defined. Blood and urine examinations usually fail to demonstrate any deviation from the normal.

Histologically it consists of a mass of granulation tissue infiltrated with histiocytes, leukocytes, eosinophiles, and giant cells or foam cells. It has often been mistaken for sarcoma, cases having been reported as cured after curettage and radiotherapy. At times it may be difficult to differentiate it from the Schüller-Christian and Letterer Siwe syndromes.

In the case reported by the author the patient was a man of 36 who gave a history of having sustained a frontal fracture two years previously, being in a coma for three days, from which he recovered without any further symptoms. The mass was incised and curetted. The histology was as described above. The author states that the prognosis in most cases is very good, the area filling in with new bone following curettage. No other treatment is indicated.

Howells and Jones[73] report 15 cases of osteoma in the frontoethmoid area which were seen at the Royal National Throat, Nose and Ear Hospital over a period of four years. Twelve were males and three females. In most of the cases drainage via the nasofrontal duct was interfered with by the growth, causing headaches and pain. Three cases were associated with a mucocele, and two cases invaded the orbit, causing displacement of the bulb. Four cases were discovered accidentally, having given rise to no symptoms. Of the 10 tumors that were removed, half were mostly cancellous and the rest uniformly dense.

Catalano's case[74] was one in which a man sustained trauma to the supraorbital region in an automobile accident, attended by very little local reaction at the time. Twenty days later, however, the patient complained of excessive lacrimation, which persisted for five months, at which time an exophthalmos with displacement of the bulb was manifest. X-rays showed what appeared to be an extension of the frontal sinus laterally. At operation a fracture line was found in the supraorbital ridge, extending into the sinus. The mucoperiosteum was stripped off the inner surface of the sinus by the accumulated blood due to the trauma. This dislocated lining became fibrosed, thus separating the adventitious cavity from the sinus proper, a situation which produced the x-ray picture simulating a bilocular sinus. The orbital cavity was not invaded, although the periorbita was displaced. The planigraphs shown by the author delineate quite clearly the hemorrhagic cavity and its relation to the sinus proper.

Richter [75] reports a case of an unusually large mucocele in a man of 64. Despite headaches of more than 20 years' duration and the appearance of a swelling over the eye, the patient delayed having anything done until the deformity had increased to remarkable proportions. The eye was displaced downward 6 cm. below the level of the opposite one, and the supraorbital swelling, which was soft and pulsating, had reached the size of an orange. X-rays revealed absorption of medial, inferior, and superior bony walls, and the anterior and posterior walls of the frontal sinus. At operation the cavity, which was filled with a dark slimy fluid, was found to be 8 cm. deep and in contact with the dura. The nasofrontal duct could not be located, so an artificial passage was created for drainage into the nose. A segment of skin measuring 3×7 cm. had to be excised to effect a neat closure.

Mucocele of the maxillary sinus is rather rare. The case reported by Christensen and Houck [76] was in a 52-year-old man who gave a history of trauma to the cheek some 29 years previously, which was followed by a temporary diplopia. A few years later a local abscess developed, discharging spontaneously. Pain and tenderness at a later period was ascribed to "high altitude sinus trouble," but no therapy was administered. About a year prior to his recent admission he developed a swelling in the cheek which grew rapidly, presenting a large, protruding, nontender fluctuating mass in the maxillary region. The eye was displaced upward, and the diplopia was marked. X-rays revealed opacity of the antrum and ethmoid with erosion of bony walls. The mass was exposed via a Caldwell-Luc approach and was found to be a thick-walled cyst occupying the entire antrum, eroding the lateral wall and roof of the antrum. The cyst was exteriorized via the nasoantral wall.

Tamari and Baer [77] claim that less than 50% of cases diagnosed as mucocele are confirmed by x-ray and clinical findings. On the other hand, x-rays may be deceiving; two recent cases thus diagnosed revealed no mucocele on surgical exploration. Thus, the authors conclude that open exploration with frozen section are necessary for a correct diagnosis. They advise the eyebrow incision, removal of the entire cystic cavity, and, if necessary, enlargement of the nasofrontal duct with drainage via a catheter sutured to the skin of the vestibule and left in place for four to six weeks. If the mucocele has eroded the posterior wall, exposing the dura, the bony opening should be enlarged sufficiently to permit complete removal of the sac. Erosion into the orbit may necessitate resuturing the pulley of the superior oblique to the adjacent periosteum.

Van Eycken [78] reports a case of a cyst of the nasal vestibule in a woman of 43, which caused a distortion of the ala and side of the nose without pain or nasal obstruction. Aspiration and filling with iodized oil revealed the mass anteriorly, although its extent posteriorly could not be made out. It was opened via a sublabial incision and found to extend backward to the posterior third of the inferior turbinate. It was densely attached to the mucosa, which had to be sacrificed in part.

The author could find only two references in the literature dealing with similar growths, which he attributes to persistence of an anterior prolongation of the nasolacrimal duct, which is found under the anterior end of the inferior turbinate in the embryo.

Silva's patient [79] was a man of 60 who had undergone an operation on the antrum for the relief of a unilateral nasal discharge. There was some improvement for a time, but the discharge soon recurred. Examination disclosed a tiny draining fistula in the alveolar scar. X-rays showed a tooth in the palate, its crown partly destroyed and in contact with a large paradental cyst. An incision through the gingival sulcus opened into a large cavity full of a fungoid material communicating freely with the nasal cavity. After the bony aperture was enlarged the antrum was entered and found to have been

markedly encroached upon by the cyst, but unaffected by the infection.

The author emphasizes the value of proper x-rays in these cases. The diagnosis in this instance was missed; therefore the failure of the first intervention.

Bertès [80] mentions four procedures for dealing with a large unilocular cyst of the antrum, namely, puncture and drainage, marsupialization, curettage, and cauterization with trichloroacetic acid. In the case which he reports marsupialization was resorted to because of the age of the patient (74) and poor cardiovascular condition. It was a very large mass which developed within a month after extraction of several teeth, obliterating the nasolabial and gingival folds and obstructing the lacrimal duct. It was entered through the mouth. The overlying bone was very thin and the cyst wall densely attached to the bone. The cavity was filled with nonodorous pus. Exploration failed to reveal any communication with the sinus. A small papilloma was found in the superointernal angle of the sinus, covering an opening into the middle meatus. The lining was not removed. The cyst cavity was cauterized with a 10% solution of zinc chloride and then packed with iodoform gauze. Epithelization was complete within one month and the swelling promptly reduced.

The second case reported by Bertès [81] involved a problem in diagnosis. Clinical signs pointed to sinusitis, whereas the x-rays findings seemed to indicate a suppurating cyst or at least an empyema of cystic origin. The patient, a woman of 45, was suffering from severe hemicrania associated with unilateral purulent discharge, photophobia, and lacrimation. Several years previously she had undergone a Caldwell-Luc operation following the extraction of a molar. There was a buccal fistula near the first molar, no swelling or crepitus, but some tenderness to pressure. X-rays showed a small triangular area pointing to the site of the fistula, where there was also a small area of bony dehiscence. Exposure through a gingival recess incision uncovered thin bone which, when removed, revealed a bluish membrane which ruptured with extravasation of a large amount of foul-smelling grumous material. It was then found that they were in the sinus cavity. The lining was completely removed, the cavity irrigated with penicillin solution, and, since it was less than normal size, due, no doubt, to the previous surgery, it was packed. Packing was changed every four days, and after two months the cavity was clean and appeared to have a new lining. The wound was then closed, and there were no further signs of discharge or other symptoms.

Eigler [82] claims that the theory of mucocele formation being the result of obstruction to the ostium, infection, or trauma is not entirely tenable. He details three cases of mucocele of the maxillary sinus, developing some 30 years after radical surgery, in none of which did the cyst tend to grow toward the nasoantral wall. The masses extended laterally and superiorly with erosion of intervening bone. The author contends that the mucocele or mucopyocele developed from rests or islands of mucosa remaining after the sinus had been cleaned out. Histologic study of the specimen in one case showed a squamous-cell lining with areas of columnar cells, and numerous mucous glands imbedded in dense subepithelial tissue.

The author concludes, therefore, that in view of the long-standing period of development (30 years) it is not conceivable that the mass was the result of passive accumulation of fluid in the closed antrum cavity, but rather to the slowly developing mucoglandular system arising from rests of mucosa.

Alema [83] reports a case of a frontal cholesteatoma associated with a pinealoma in a man of 46. He had suffered severe headaches for several months, followed by Jacksonian fits, diplopia, ptosis, and a syndrome of Weber. An exploratory temporal craniotomy was negative.

The autopsy revealed a cholesteatoma the size of a hen's egg implanted in the dura and imbedded in the white substance of the frontal lobe; it contained masses of choles-

terin crystals, hair, and nails. In addition they found a pinealoma in the hypothalamic-mesencephalic area which destroyed the oculomotor roots, part of the cerebral peduncle, the red nucleus, and other vital areas. The author attributes the pathology to a dysembryogenetical mechanism occurring during the fifth week of fetal life.

Hörbst and Schlorhaufer [84] presented a brief report of three cases of brain neoplasms invading the sinus areas. These included a meningoblastoma, a meningeoma, and a spongioblastoma. The details were not given. Vyslonzil, discussing the presentation, mentioned a similar case he had seen in which a rather dense mass appeared at the root of the nose, accompanied by severe headaches. From the x-ray pictures it was considered to be a mucocele. However, when exposed it proved to be a meningeoma protruding between the small frontal sinuses. The author surmised that the growth originated during the second or third fetal month from a falx anlage, remaining dormant until activated into progressive growth by causes unknown.

Weichselbaumer [85] had an interesting case in a woman of 69 who presented an erysipeloid well-defined swelling below the eye which defied the efforts of the ophthalmologist and dermatologist. It proved to be a gumma originating in the soft tissues of the cheek, breaking through into the antrum and ethmoids and attacking the nasal bridge before it was brought under control. The original infection was contracted 30 years before.

### Surgery of the Sinuses

Horgan [86] describes in great detail the technique of the Caldwell-Luc and transantral ethmoidectomy, which he has modified in various ways. In addition to the usual premedication he injects the infraorbital nerve in the pterygoid fossa as well as the maxillary nerve in the region of the sphenopalatine fossa. Also the anterior ethmoid nerve is blocked and some local infiltration along the line of incision. The latter, instead of being the usual horizontal one, is diagonal from a point near the malar prominence downward to the root of the ipsolateral upper cuspid. After the antrum is cleaned out the ethmoids are approached through the obtuse angle between the lamina papyracea and the medial margin of the orbital surface of the maxilla. The middle turbinate serves as an important landmark and is not disturbed until the end of the operation, when a portion may be removed if found diseased.

The instruments which he uses are shown, and comprise a modification of Hajak's retractor, Moure's curettes, Horgan's serrated long forceps, Luc Lilley's forceps, Horman's antrum elevator, and special ethmoid forceps, etc.

The author is very conservative in his treatment of sinus disease in children, and rarely resorts to surgery. Most cases can be cured by proper dietetic and hygienic care, plus displacement therapy and irrigations.

The relationship of the tonsils and adenoids to sinusitis in children he has found more frequently the reverse of the generally accepted view. Proliferation of lymphoid tissue in the nasopharynx is more frequently the result of sinus disease rather than the cause. It is important in all such cases to investigate the sphenoids, which are commonly affected in association with ethmoid and antrum disease.

The author is very much opposed to intranasal antrostomy because of the tendency for the opening to close and because of the trauma to the inferior turbinate.

Prietzel [87] reports successful results following intranasal antrostomy in 14 patients with chronic maxillary sinusitis. The postoperative healing period averaged 10 days. The author is impressed with the simplicity of the procedure as compared with the Caldwell-Luc and mentions the short period of convalescence, comparative absence of pain and sensory disturbances. Also the fact that the mucosa of the sinus is left intact to recover by reason of the improved

ventilation and drainage is one of the major advantages of this operation.

Belvèze,[88] reporting a case of radicular cyst of the antrum following an infection of an adjacent tooth root, discusses the surgical approach which is aimed at removing the diseased root without infecting the sinus. Much depends on the preoperative findings, because if the sinus is unaffected and the tooth is not in juxtaposition to the antrum floor, one must avoid opening the latter. However, if the root of the tooth projects into the sinus, even though the latter is not involved, one must open it to remove the infected root. The risk of a secondary sinusitis developing from an infected tooth is greater than the consequences of opening a healthy sinus, particularly if antibiotics are used. If the sinus is already infected, there is no problem. The procedure should be as follows: First, open the sinus; second, remove the infected root, and, third, repair the mucosal breach and evacuate the hematoma in a day or two, all under the control of antibiotics. The author stresses the importance of salvaging the remainder of the tooth after resection of the root, which, of course, is strictly the dentist's concern.

Unterberger[89] extols the virtues of the coronal incision for operations on both frontal sinuses from the cosmetic point of view. There is no deformity because the supraorbital ridge is not disturbed, nor the periorbita separated. Drainage is effected directly into the nasal cavity and not through the ethmoid mass. If the ethmoids are to be exenterated it is best done via the intranasal approach.

Tato and Arauz[90] describe their procedure for puncture drainage of the frontal sinus. It is indicated for aspirating secretions, sinus lavage, injection of air to test the permeability of the duct, and instillation of antibiotics and opaque substances for x-ray study.

The point at which the opening is to be made is determined after a study of the x-rays. A line is drawn across the superciliary borders intersected by a line from the center of the root of the nose upward following the intersinus partition. The latter is important, since this wall frequently deviates from the midline. The opening is made directly through the skin, which is stretched taut, and the bone at a point along a line which bisects the two lines previously marked out opposite the deepest part of the sinus as shown in the x-rays.

(It is difficult for me to understand why the authors elect to go through the dense anterior wall of the sinus when the approach through its thin floor is so much easier and less dangerous. S. S.)

Along the same line is the contribution by Díaz,[91] in which he describes diagnostic puncture of the maxillary, sphenoid, and frontal sinuses. For the frontal sinus, he follows Lemoyne's technique, going through the anterior wall at the point described above by Tato and Arauz, employing a motor-driven trephine. The trocars he shows for puncturing the antrum are slightly curved, and the sphenoid trocar is straight. These procedures, he claims, are easily carried out without pain, under local anesthesia, and without danger if controlled by previous x-ray studies.

Smith, Clopp, and Williams[92] report a case of carcinoma of the frontal and ethmoids which was subjected to a very radical operation in which the entire orbit, frontal sinus, ethmoids, medial wall of antrum, turbinates, and septum were removed en bloc. It was done by a general surgeon in cooperation with a neurosurgeon via a frontal osteoplastic flap based on the temporal muscle. Extradural dissection exposed the floor of the frontal fossa as far back as the sphenoid ridge. The incision was carried down the side of the nose and outward along the orbital ridge, as in the Moure or Ferguson operation. After the mass was removed the osteal flap was sutured back and the cavity lined with a split graft.

There was some meningeal reaction on the sixth day, which, however, subsided, and a frontal lobe type of mental aberration which lasted several weeks.

The patient recovered and appeared to be free from disease when seen a year later.

A query [93] as to the degree of bone regeneration following mastoidectomy and antrostomy is answered insofar as the antrum is concerned, by the following: "A certain amount of new bone formation occurs around the edges of the opening between the antrum and inferior meatus." This is more likely if bone fragments are left attached to the mucosa. This leads to narrowing and eventual closure in many cases. However, the cavity of the nose and the antrum cavity are not encroached on.

This is one of Bergara's [94] earlier reports on the rate of fat transplants for obliterating the frontal sinus following surgery. Some of his later papers on the subject, particularly the one in the ARCHIVES for June, 1955, elaborate further on the clinical application of this procedure and the results obtained in a number of cases. The report herewith abstracted has to do with the histologic study of some fat previously implanted and subsequently removed because of a secondary infection. It shows that the fat implants survived despite the infection and are well vitalized, undiminished in bulk, and surrounded by newly formed fibrous tissue binding it to the bone and the exposed dura.

Haedo [95] writes on the same subject and shows some pictures taken two years after a fat-implant operation. These seem to reveal new bone formation as well as a beginning repneumatization of the previously obliterated sinus. He speculates on the possibility of the newly formed space originating by ingrowth from the nasofrontal duct.

Macbeth,[96] referring to the work of Gibson and Walker (*British Journal of Plastic Surgery* 4:210, 1951) describing an osteoplastic operation on the frontal sinus, reports his experience in 16 cases operated upon by this method. Three of these were for osteoma, seven for chronic infection, and six for mucocele. The only modification introduced by the author is a method of "mapping" the outline of the sinuses. Two pieces of wire are fastened to the forehead by adhesive at right angles to each other, one on each side of the midline about an inch apart, and an x-ray picture is taken. The film is then cut away at the outline of the sinuses, and the pattern thus remaining is placed over the forehead so that the images coincide with the original pieces of wire. The outline is then traced with indelible pencil. The scalp incision is in the hairline from temple to temple. After hemostasis has been accomplished four or five hypodermic needles are passed through the flap along the pencilled outline of the sinuses to mark it on the pericranium, which is incised in the same place as the skin cut. After the pericranium has been stripped forward the anterior wall of the sinuses is perforated with a burr in a number of places alongside the marking needle. The needles are then removed and the burr holes connected by a cutting burr. The osteoplastic flap is pried forward hinging on the supraorbital ridge. The pathology in the sinuses is then dealt with, including complete stripping of the mucosa and exenteration of the ethmoid if necessary. Drainage into the nose is adequate until the cavity obliterates, which, according to the author, usually eventuates. From the cosmetic point of view the results are ideal, and judging by the cases cited the end-results from the pathological standpoint leave nothing to be desired.

The illustrations of this article are unusually clear and illuminating.

Harpman [97] contends that few cases of nasal polypi are entirely due to allergy and therefore amenable to antiallergic therapy. Believing that secondary infection is usually present, he advocates complete removal by exenterating the ethmoids. Minor cases can be cured through intranasal procedures, but in many cases recurrences will be the result. He therefore proposes surgery via the external route, and, among the various procedures mentioned, he prefers the Lynch, Sewell, or Luongo approach. By this technique the ethmoids, frontal, and sphenoid

can be adequately dealt with. It is his opinion that after removal of the frontal sinus mucosa in most cases the cavity will be obliterated by scar tissue. Also, by removing some bone from the inner portion of the infraorbital margin, being careful to avoid damaging the nasal duct, one can gain access to the antrum and remove its contents as well as via the Caldwell-Luc approach. Photographs of several stages of the operation are not clear because of reflected highlights from the instruments in situ and insufficient contrast between the various tissues.

The author does not favor the transantral approach to the ethmoids because he claims that the anterior cells are inaccessible.

Also it should be noted that in some cases of extensive polyposis the author employs deep x-ray therapy.

Pagano [98] reports success in the treatment of certain types of frontal sinusitis without demonstrable secretion. These cases have at times been termed occult, hyperplastic, nonsuppurative, etc., and are characterized by recurring unilateral headache radiating from the inner orbital angle. X-rays reveal slight cloudiness of the sinus, which is usually smaller than average. Treatment consists in the exposure of the floor of the sinus via a supraorbital incision measuring about 2.5 cm. in length, elevating the periosteum, and removal of a button of bone to expose the mucosa, which is also opened. The findings consist of a thickened periosteum usually loosely attached, spongy thickening of the bone, and a hyperplastic mucosa. The nasofrontal duct is usually patent. The cavity is filled with a sulfonamide powder and the incision is closed. Headache disappears within 24 to 48 hours, and the relief is permanent.

The author explains the phenomenon on the basis of an inflammatory irritation of trigeminal and sympathetic fibers accompanying the vessels, these fibers being interrupted by the surgical procedure. Filling the cavity with a sulfonamide powder is presumed to control the bacterial invaders.

Gibson and Walker [99] cite three cases successfully operated on via the osteoplastic approach previously described by the same authors (*British Journal of Plastic Surgery* 4:210, 1951). These consisted of an osteoma, a suppurative sinusitis due to recurring acute attacks, and a case of mucocele. A skin flap originating above the hairline is turned down and the anterior plate of the frontal sinus, previously delineated through x-ray picture, is fractured downward, hinging at the supraorbital border. The pathology exposed is dealt with according to the indications, all mucosa being removed except in the vicinity of the duct. Primary closure with temporary drainage externally results in normal contour of the forehead and no visible scar.

Ellis [100] disagrees with those who would avoid removing the frontal process of the superior maxilla, portions of the nasal bone and lamina papyracea, in operations on the frontal sinus. He claims that if sufficient bone is taken away, including the spine and the anterior ethmoid cells, the newly constructed wide channel will remain patent if kept open long enough to permit a cicatricial lining to develop. This can be accomplished by using a wide plastic tube which fits the passage tightly and is left in place for as long as 14 months. One case observed for three years postoperatively showed a smooth clean channel only slightly smaller than the original. The results in six cases were all good.

Conley [101] demonstrates the value of immediate skin grafting to raw areas resulting from extensive dissection of malignancies about the head and neck. In cases of excision of the maxilla, orbit, ethmoid, and sphenoid, which may at times involve all the tissues to the base of the skull, even exposing the dura, the extent of exposed raw areas is considerable. Immediate coverage with split skin grafts, supported by a pack for a week to 10 days, not only shortens the convalescent period but contributes greatly to the patient's comfort. This procedure promises success in most cases

through the efficiency of the antibiotics which are routinely administered. Naturally one would not employ a free graft if the adjacent tissues were sufficiently mobile and adequate to cover the defect. Also, if the area has been subjected to heavy irradiation the chances for success would be diminished, since devitalized tissues do not offer a satisfactory bed for grafting.

A group of four articles on the subject of surgical correction of the septum for the relief of atrophic rhinitis was presented at the Third Argentine Congress of Otolaryngology, and appear in the special edition of the Proceedings.

González Loza [102] resects the quadrilateral cartilage and then reinserts it in the horizontal plane, thus producing a ridge that projects into both nasal chambers.

DeSebastián [103] uses an acrylic implant introduced through a sublabial incision from which the septum is freed on both sides. He sets forth certain contraindications to this procedure, namely, patients past the age of 50 or 60, cases of malnutrition, local infection, syphilis, tuberculosis, etc. Among the immediate complications mentioned are hemorrhage, damage to the infraorbital nerve, injury of the lacrimal duct, and laceration of the mucosa. Late complications include edema and hematoma, nasal obstruction, infection, and foreign-body reaction.

Lanza Castelli [104] quotes Eyries, with whom he worked at the Hospital Larivoissiere in Paris and who was an exponent of the acrylic implant. The implants, measuring 2 to 5 cm. by 3 to 5 cm., are inserted via a sublabial approach, which they consider safer than an intranasal incision as regards the possibility of infection. Also, the tissues can be freely elevated, permitting a better view of the spaces to be filled, the object being to place the implants opposite the areas of the lateral wall where the crusting is most prominent. Eleven cases are cited.

Luque and González Leynaud [105] claim excellent results from the use of placental implants into the septum. They take a portion of the placenta from the region of the pedicle, subject it to a temperature of 2 degrees below zero for five days, after which it is thoroughly washed in sterile saline and then cut into small segments for implantation. Most of the cases reported were observed for a period of several months, the results being good at that time.

Garcia [106] gives an account of his results in a series of radical resections over an 11-month period. Twenty-one resections were done, and there were four deaths. In nine cases the maxilla and orbit were exenterated; three of these died. In seven partial resections, saving the orbit, there was one fatality. He describes the procedure in which the maxilla is removed along with the nasal bone, zygomatic arch, and lateral orbital wall. The ethmoids, frontals, and sphenoids are explored and exenterated if indicated.

He states that of late they have had more partial resections, sparing the orbit and palate. This is probably due to earlier diagnosis and earlier resort to surgery.

Hofer and Fioresi [107] employed Poppen's modification of Naffziger's operation for decompressing the orbit in three cases of malignant exophthalmos, with good results. They claim that the most important step in the procedure is the removal of the outer portion of the optic foramen, especially in cases with marked loss of vision. This is not always easy because of the dense attachment of the dura at this point. They have noted simultaneous improvement in both of the eyes following surgery on only one side, which they claim is due to the effect on the vegetative nervous apparatus.

In addition to removing the roof of the orbit and the external portion of the optic foramen, the external orbital wall is taken down into the temporal fossa and the orbital fascia incised to permit the swollen ocular muscles and orbital fat to expand in that direction. Small drains are inserted through which penicillin solution may be instilled

and light pressure over the bulb is exerted by means of a partially air-filled condom.

### Nonsurgical Therapy

Hill [108] comments on the radical changes that have taken place during the past generation in our treatment of chronic sinusitis. The days of ruthless surgery of the nose and sinuses have passed, and in its place we have a wholesome regard for the integrity of the normal defenses and an understanding of the factors which make for chronic nasal symptoms, such as allergy, endocrine disturbances, and other constitutional conditions. To properly appraise all these elements requires careful history-taking and an examination that embraces far more than the local inspection.

If surgery is indicated it should be based on sound pathologic indications and should aim at adequate ventilation and drainage with minimum destruction of functioning tissues. Closure of antrostomy opening can be prevented by a properly fashioned mucosal flap laid down over the denuded bony breach. Similarly the nasoantral window in the Caldwell-Luc procedure can best be maintained by working from the antrum toward the nasal cavity rather than the reverse. Regarding surgery in general, the author concludes with this statement: "Operate when indicated and radically if necessary, but only with an intelligent comprehension of the entire problem, and with a clear conscience."

Kumpf's article [109] is more or less a summary of the literature on sinuses over a five-year period, and reveals some of the trends in diagnosis and therapy. Among the highlights that are stressed are these:

1. The local use of antibiotics is usually ineffectual and may be harmful in sensitive persons.
2. Prolonged use of vasoconstrictors is to be condemned, since it leads to drug sensitivity and lasting engorgement of the mucosa.
3. Oily sprays may cause lipopneumonia.
4. Allergic and constitutional factors play a prominent role in the incidence and persistence of sinusitis.
5. Aerosol with various medicaments is ineffectual.
6. Autogenous vaccines in chronic cases may be helpful.
7. Short-wave therapy, change of climate, and general constitutional therapy are always of value.

Goodale,[110] addressing general practitioners, covered the essential features of acute sinusitis, diagnosis, and therapy. Antibiotic therapy should not be discontinued until there is objective evidence that the infection is conquered, such as subsidence of discharge, lessening of nasal turgescence, and clearing of the sinuses on transillumination. He also emphasizes the importance of good general care and attention to factors which might predispose to recurrences.

The salient features of osteomyelitis and orbital abscess are properly described.

Other points emphasized by the author are the need for bacterial studies where antibiotics are required, the importance of being on the alert for a possible malignancy in the early stage, and the value of proper coordination of constitutional therapy with the local treatment.

Blegvad [111] has found a preparation called Nebacetin more effective in the treatment of acute and chronic maxillary sinusitis than penicillin. It is a combination of neomycin sulfate and bacitracin, and has been proved bactericidal to the entire bacterial spectrum in vitro. He claims that half his cases recovered after a single instillation of Nebacetin following irrigation.

Nielsen [112,113] found Leocillin, a penicillin derivative, superior to procaine penicillin G in the treatment of acute maxillary sinusitis. Seventy-two patients (one hundred one antrums) were divided into two groups; every other patient received 300,000 units of penicillin daily, the others being given the same amount of Leocillin. Fewer operations were required in the latter group, and the convalescent period of the group not operated on was also less, averaging 5.1 days as against 7.9 days in the penicillin cases. Considering Leocillin's excellent effect in cases of otitis media, the author concludes that the antibiotic has an affinity for all infections involving the mucous membrane of the respiratory tract.

Felisati [114] employed a penicillin filtrate via aerosol in 48 cases of both upper and respiratory infections, with 37 cures within a period of from 2 to 15 days. Among these were four cases of chronic sinusitis, two of which were cured, one relieved, and one unsuccessful. Treatments were given twice daily for an average of seven days. Since the type of infection or its duration were not given in the article, it would be difficult to draw any conclusions.

Bablik [115] claims to have had excellent results from the local application of a chlortetracycline (Aureomycin) ointment in the nose in cases of bacterial and nonbacterial affections. Chlortetracycline, 0.1%-1%, in a petrolatum (Vaseline)-wool fat (lanolin) mixture with a low melting point is smeared over a pledget of cotton, which is inserted into the nasal cavities and allowed to remain for 30 minutes. It is then withdrawn and the patient is instructed to vigorously blow the nose. The treatment is then repeated and the patient told to retain the cotton plug as long as possible. This therapy is administered three times daily. One hundred acute and subacute cases of rhinitis thus treated were afforded marked relief.

Rost and Schlink [116] describe a more efficient method of administering short-wave therapy to the sinuses than the standard position of head with electrodes equidistant on each side. The distance between the plates is increased to 17 in. to allow the patient's head to avoid the nodal position. Treatment is given with the patient's head first near one plate and then near the other, and held at the angle which presents the flattest surface to the plate.

However, despite the improved technique, the results so far as curing the sinusitis are concerned have been disappointing. Penicillin inhalations also were ineffective. Only when penicillin was given parenterally over a period of six days was a definite result obtained.

The authors are concerned about the recurrences after primary improvement, and point to the need for more research as to the reasons for chronicity. They suggest the possibility of an analogy between recurring sinusitis and the typhoid carrier state.

Arbesser [117] points out the fallacy of employing vasoconstrictors for the relief of vasomotor rhinitis. The temporary relief afforded by these drugs is soon followed by a period in which the vasodilation returns, and sooner or later the effects of these drugs are of shorter duration, whereas the subsequent reaction is severer and lasting. Thus nothing is accomplished and in the end the patient is worse off. The moral, which, of course, is well known, is that these cases require intensive study for the elimination of the etiologic factors.

A query [118] as to the availability of an effective vaccine against the common cold is answered in the negative. "Antibacterial vaccines may be of value against secondary infections, but there is no good justification for using them in a widespread manner."

Kral [119] reports nine cases of purulent sinusitis in the horse, diagnosis being made through direct rhinoscopic examination. Pus can be seen issuing from the vasomaxillary opening. These cases were successfully treated by flushing the sinus through an external opening that was made with a Steinmann pin or bone drill. Pancreatic dornase or streptokinase was used to reduce the viscosity of the secretions, following which instillations of suitable antibiotics were employed.

Agazzi [120] claims that penicillin when given together with sulfonamides orally acts synergistically and more effectively than penicillin alone. The oral dose of penicillin given in this manner should be at least four times that employed parenterally. He found also that in cases where penicillin alone was ineffective given parenterally it seemed to become activated when given with sulfonamides by mouth. As proof of this conclusion the author submits records of cases of subacute sinusitis previously resistant to penicillin parenterally administered, in which the combined oral therapy resulted in three

cures and two improved. The average duration of treatment was 5 to 10 days. In six acute cases the average duration was three to eight days, with cures in all cases.

Vickers,[121] in a series of 75 cases of pollenosis due to grasses or ragweed, obtained "adequate or complete relief" in 80%. He believes the good results can be attributed to the combination of an antibiotic with the decongestive and antihistaminic agents. Undesirable reactions were few and were due to excessive use of the agent.

Anderson and Rubin[122] report favorable results from the use of Hydergine † in 326 cases of various otorhinologic disorders. These include vertigo, hypertensive epistaxis, dryness of the mouth, glossodynia, postnasal discharge, atrophic rhinitis, etc. Benefits are attributed to the pharmacologic action of the drug, which are vasodilation, fall in blood pressure, central sedation, andrenosympathicolytic effect, and increase in venous pressure.

Ojala and Kortekangas[123] conducted a series of experiments on 233 children of primary school age to determine the effectiveness of commercial vaccine in the prevention of colds. The children were divided into two groups, half of whom were given the vaccine, the other half receiving shots of a typhoid-paratyphoid vaccine. The results indicated that the cold vaccine had no specific effect on cold symptoms or complications.

Smith[124] found that only 6 out of his 20 cases of frontal sinus disease manifested nasal symptoms and rhinologic findings. The remainder were all associated with symptoms referable to adjacent structures. Ten of these were the result of obstruction to the nasofrontal duct. Six of these showed typical x-ray pictures of a mucocele, such as absence of scalloping of the sinus wall, increased translucency, and flattening of the medial superior margin of the orbit. The author concludes on this point that these conditions are not specific entities, but rather the result of changes in the sinus walls due to pressure of accumulating fluid resulting from obstruction of the normal sinus outlet. Trauma and secondary infection may produce lesions affecting the frontal sinus without causing any nasal symptoms. Typical cases are described. The author comments on the importance of adequate x-ray studies, with contrast media if necessary, and advises minimum delay in exploration and thorough eradication of the pathology. Antibiotics are useful as complementary aids in the therapy.

### Clinical—Hyperostosis Frontalis

Solomon's[125] prize essay includes the history of the Morgagni-Morel syndrome with an analysis of the various endocrine, metabolic, and neuropsychiatric disorders and their relationship to basic pituitary dysfunction. The symptomatology is variable, depending on the type and degree of the dysfunction. As a result, several types have been described by various authors, the details of which are included in the article.

Of interest to otolaryngologists is the analysis of the various types of calvarial thickening, particularly in the frontal bone. As described by Moore, quoted by the author, there are four distinct types:

1. Hyperostosis frontalis interna, where a deposit of cancellous bone on the inner table is seen in the x-rays, covered on its intracranial aspect by smooth compact bone. The density progresses from the inner table outwardly through the diploe and may be nodular or sessile.

2. Nebula frontalis, in which there is a triangular or elliptical area of increased density in the squama frontalis.

3. Hyperostosis calvariae diffusa, when the entire bony vault is involved.

4. Hyperostosis frontoparietalis, considered to be an early stage in the development of a generalized hyperostosis.

Cases in which there have been no demonstrable bony changes in the skull have been cited by several authors. However, being present in the vast majority of cases, it is definitely linked up with the pituitary disorder and when seen for the first time

† A mixture of the methanesulfonates of dihydroergocornine, dihydroergocristine, and dihydroergocryptine.

should lead to a neurological investigation.

Baruffaldi and Bonifaci [126] present a long and detailed dissertation on the Morgagni syndrome based on observation of seven cases ranging in age from 26 to 76 years. Numerous histologic sections are shown from the various endocrine glands depicting changes in the structure, disposition, and character of the cells. The two youngest patients (ages 26 and 35) were particularly instructive because the process was still in the active stage. The findings were a preponderance of chromophobe cells in the anterior lobe of the pituitary, hypertrophy of the adrenal cortex, functioning ovaries, and indifferent changes in the parathyroid and thyroid glands. According to the authors, the differences between the young and the old patients with this disease agree with Warter's concept.

Schuleman [127] found 17 cases (3.3%) of hyperostosis frontalis interna in a series of 510 skull films which he examined. The greater majority were in females. Encephalograms in this group showed signs of cerebral atrophy in five; seven were normal and five were unsuccessful. A high percentage (70.6%) of these patients were subject to convulsive disorders.

Paltrinieri's [128] long article has to do with the relationship of hyperostosis with homosexuality, as illustrated by a case which he cites and discusses at great length. It has no bearing on the sinuses, which appeared normal although smaller than average.

Lopez-Porrua and Enriquez de Salamanca [129] report a case of hyperostosis frontalis interna which was not associated with the usual signs of pituitary dysfunction. Ventriculograms revealed a space-filling mass in the temporoparietal region, which at operation was revealed as an organized hematoma pressing into the Sylvian fissure and the anterior portion of the first and second temporal convolutions. There was no history of trauma. However, in another case which they cite, there was a report of some previous trauma.

The authors list the points of similarity between their cases and true Stewart-Morel syndrome, as well as the points of dissimilarity. Apparently hyperostosis may be due to causes other than pituitary dysfunction.

Appleman and Moehlig [130] report two cases of metabolic craniopathy with concomitant osteopoikilosis in a mother and daughter. The evidence points to a sex-linked hereditary factor, and the hyperostosis is due to a pituitary dysfunction. X-rays show involvement of dorsal and lumbar vertebrae in addition to the sclerosis of the skull. The sinuses, as usual in these cases, appear smaller than average.

In connection with the case of a 30-year-old man with hyperostosis frontalis, Spiegl [131] describes the ether test, which he claims is effective in diagnosing the functional capacity of the hypophysis. He injects 0.1 cc. of pure ether intracutaneously into the skin of the upper arm. In 90% of normals the typical reaction consists of a central hemorrhagic zone measuring 2 to 3 mm. immediately around the point of injection, which is anemic. Surrounding the hemorrhagic zone is another zone of anemic skin, somewhat ring-shaped, and some hyperemia beyond. After two to three weeks a scab forms over the central zone, which peels off, leaving a small scar. This reaction is recognized as typical and normal and is diminished or absent in persons suffering from disorders of the hypophysis and diencephalon, particularly where the control of fat formation is concerned.

Spiegl's patient gained weight and libido after the implantation of a sheep's anterior pituitary.

Hyperostosis frontalis interna is uncommon in the male. A case involving a 34-year-old Negro is reported by Stern and Hollander.[132] The patient complained of recurring severe headaches beginning in the frontal area and spreading over the entire head. There were no other complaints, although note was taken of an increase in weight four years previously amounting to about 40 lb. X-rays revealed increased density in the cancellous bone, limited to the squama frontalis.

Ear, nose, and throat and neuropsychiatric examinations reported normal findings, although at one time during his hospitalization he was found to be glum and unresponsive. Aside from morphine, he obtained no relief from general therapy, such as rest, vitamins, thyroid extract, and anodynes.

Sapuppo's [133] case is of interest because of the association of a retinal-choroidal and endocranial angiomatosis in Morgagni's syndrome. He states that the unilateral retinal venous stasis could in itself establish the diagnosis.

One of the cases presented by Schmidt [134] was characteristic of the Stewart-Morel-Morgagni syndrome, causing concentric constriction of the visual fields, temporal pallor of the papillae, relative central scotoma, neuralgia, and other disturbances. X-rays revealed typical hyperostosis frontalis interna.

On the basis of eight cases which he describes, Ketz [135] summarizes as follows:

The outstanding subjective symptom of the Morgagni syndrome is headache, usually of the migraine type. The manifestations of the disease consist of the triad, hyperostosis frontalis interna, adiposity, and virilism. Hypertonia, diabetes mellitus, and psychic disorders are less common.

Pathologically it is a disturbance of the central regulatory system in the midbrain hypophyseal area, based on a hereditary disposition and a disturbance in hormonal equilibrium.

Therapy is purely symptomatic, consisting of procaine hydrochloride (Novocain) therapy, hormone substitutes, and Hydergine.

### Kartagener Syndrome

Tarantino's [136] case was in a 20-year-old woman who gave a history of chronic cough with abundant expectoration of greenish-brown secretion, often blood-tinged, and nasal obstruction since early childhood. There were frequent exacerbations with fever, and the patient was asthenic and anemic. Examination revealed a dextracardia, bronchiectasis involving the lingual segment of the left lung, chronic maxillary sinusitis, and agenesis of the frontals. The treatment indicated consisted of general tonic medication, administration of antibiotics (oral, parenteral, and by aerosol), surgery of the maxillary sinus, and resection of the affected pulmonary segment.

Two cases of Kartagener's triad are described by Gross,[137] one in a man of 67, the other in a woman of 38. In the first case the bronchiectasis, emphysema, and sinusitis were well marked and chronic. Bronchiograms showed typical situs inversus.

The second patient had a history of tuberculosis, for which she had been treated in a sanitarium. X-rays showed situs inversus, fibroid tuberculosis of the right upper lobe, bilateral bronchiectasis, and retention cyst of one antrum.

Three cases of Kartagener's syndrome are reported by Katz, Benzier, and Nangeroni.[138] The first was in a 15-year-old girl. There was a history of frequent upper respiratory infections since childhood with chronic nasal discharge and cough. Examination revealed a situs inversus, bilateral bronchiectasis, and hypoplasia of the frontal sinus. A 14-year-old sister gave a similar history. X-rays showed a dextracardia, transposition of the stomach, hypoplasia of one frontal sinus, and agenesis of the other. The third case was a 19-year-old woman who had a nasal operation a month ago and who knew that she had complete transposition of the viscera. This was confirmed by the examination. There was a minimal bronchiectasis of the right middle lobe.

### Maxillary Sinus

McKenzie [139] discusses several aspects of maxillary sinus disease, mentioning the relationship to chronic cough, deafness, and general ill health. He shows a picture of a child with a swollen face, which might be attributed to an antrum infection, but was really due to an infected tooth, by way of illustrating possible errors in diagnosis. Concerning x-ray pictures, he is less willing to diagnose a sinus infection on that evidence

alone, being convinced that antrum puncture and examination of the fluid is far more reliable. When irrigations have to be repeated he had found it helpful to introduce a fine polyethylene tube into the antrum through the trocar, the tube being strapped to the face and left in place to facilitate the irrigations. It is especially helpful in children.

When surgery is indicated he prefers intranasal antrostomy to the Caldwell-Luc.

Dentigerous infections of the antrum and new growths are also briefly discussed and cases cited.

Kelemen [140] believes that there is an association between obesity and sinusitis. This is based on the observation of 48 cases of maxillary empyema, in 36 of which the body weight deviated upward from the normal average height-weight ratio. Fifteen of these averaged over 20% above the normal ratio. It is reasoned that excessive weight places an additional burden on the glandular system, rendering the patient less able to cope with infection.

Tuberculosis of the sinuses is very rare, only 32 cases having been reported. Gibson and Prain's [141] case was in a woman of 30 who noted a painless swelling of the cheek, of one month's duration. It was the size of a pigeon's egg, apparently adherent to the periosteum just below the zygoma. The antrum was cloudy. A Caldwell-Luc approach was employed, and the bone of the canine fossa was found to be stippled and very thin. The mass was dissected out of the tissues of the cheek, the antrum was opened and a thick hyperplastic membrane removed.

Histologic examination revealed massive proliferation of tuberculous infection with many giant-cell systems. There was no evidence of fungus infection. Efforts to recover tubercle bacilli by stain or culture failed. The patient recovered after 13 weeks of streptomycin sulfate therapy, 3 gm. weekly.

The authors suggest that the lesion was due to casual inhalation of tubercle bacilli into the sinus.

Boies [142] lists the types of chronic maxillary sinusitis as follows:

1. Purulent, often foul, and frequently of dental origin with associated saprophytic invasion.
2. Hyperplastic with polypi and cyst formation; may be allergic and frequently associated with ethmoid disease.
3. Cystic; may invade the nasal cavity.
4. Malignant.

The diagnosis depends on the x-ray findings, with contrast media if necessary, and the results of irrigation.

The relative merits of intranasal antrostomy and the Caldwell-Luc are discussed. The author favors the latter in edentulous patients and in cases where thorough visualization is important. In 32 cases, mostly of dental origin, the intranasal approach was used 11 times and the Caldwell-Luc 21. All remained clinically well.

Puljo's [143] article is chiefly a plea for cooperation between otolaryngologists and stomatologists in the diagnosis and treatment of maxillary affections. Symptoms may be referable to one field, while the pathology arises in the other. Errors in diagnosis are common because frequently the specialist in one field is unfamiliar with conditions in the adjacent territory.

Bennett and Moore [144] divide their 29 cases of oroantral fistula into two groups—recent uncomplicated fistula and complicated fistula, the latter comprising the majority (24). The complicated cases are subdivided as follows:

1. Recent fistula with preexisting sinusitis, usually chronic.
2. Recent fistula with acute sinusitis.
3. Fistula with resulting subacute sinusitis.
4. Fistula with resulting chronic sinusitis; fistula usually epithelized.
5. Fistula with foreign body in tract or antrum.
6. Fistula with fibrosis along the tract.
7. Fistula with epithelization of edges.
8. Fistula with osteitis or osteomyelitis.
9. Fistula with malignant change.

In their group of complicated cases they had 3 with acute sinusitis, 10 with subacute sinusitis, 9 with chronic sinusitis, and two with foreign body.

They recommend x-ray studies, at times with contrast media, for diagnosis of for-

eign body as well as the status of the antrum mucosa.

Factors concerned in the production of fistula are anatomic (dehiscence of bone above the tooth apex or thin intervening bony layer); traumatic, such as excessive violence in the extraction or unnecessary zeal in curetting the socket.

Factors tending to maintain the fistula are a large fistula, presence of infection, epithelization, osteitis, or foreign body. Also closure may be delayed in patients suffering from general debility, tuberculosis, or patients taking corticotropin or cortisone.

In the treatment of their cases they found that half of the complicated cases closed spontaneously after the associated sinusitis had been treated. The remainder were subjected to surgery of the sinus and plastic closure of the fistula.

A recent fistula without sinusitis may be promptly closed by primary suture, providing x-rays fail to show a foreign body. If an acute sinusitis is present the treatment should be conservative, even omitting antrum irrigation. If subacute sinusitis is present the antrum should be irrigated and procaine penicillin G instilled. If the fistula persists after the sinusitis has been cured it should be closed by surgery, since reinfection is likely to occur.

If a chronic sinusitis is present the antrum should be cleaned out through a sublabial approach.

In some cases the fistula healed spontaneously. Of nine cases requiring radical sinus surgery, four closed spontaneously after the sinusitis was cured. It is apparent, therefore, that the patient has almost a 50/50 chance for spontaneous closure, thus obviating the necessity for plastic repair.

Crocquefer[145] states that in a case of sinusitis presumably due to a dental focus it is better to do a Caldwell-Luc, which affords an opportunity to inspect the area in the floor of the sinus overlying the suspected tooth before deciding to extract the latter. In some cases the tooth may not be at fault. On the other hand, to extract a diseased tooth without opening and cleaning out the affected sinus would only lead to a secondary operation. The objective in any case is to achieve the maximum of security with the least amount of mutilation.

Marfort[146a] gives the causes of antrobuccal openings as (1) traumatic (accidental or surgical); (2) infection resulting in osteitis; (3) necrosis due to radium or toxic substances such as bismuth, phosphorus, or mercury, and (4) trophic. Small fistulae may well be taken care of by means of a dental prosthesis attached to adjacent teeth and covering the aperture. Larger openings require surgery, and, as a rule, the invaginated scar tissue about the opening is used as the deeper layer, which is then covered with a flap derived from the adjacent tissues. The author describes the Wassmund procedure, also the methods publicized by Kazanjian and Converse.

### Frontal, Ethmoid, Sphenoid

Laudanski,[147] after a description of the pathology of acute frontal sinusitis, discusses various methods of therapeutic management. In the milder cases conservative treatment is to be applied: bed rest, analgesic drugs, antibiotics, and drugs causing constriction of the blood vessels intranasally. The last-named should not impair the function of the mucosa; should have a pH of 5.5 to 6.5. These requirements are met by the 0.5% solution of ephedrine in physiologic saline and solutions of penicillin in isotonic saline (1000 to 5000 units per milliliter); other drugs, such as epinephrine, silver preparations, 5% sulfathiazole, solutions of menthol, camphor, eucalyptus oil, and cocaine, injure the mucous membrane to various degrees.

In the clinical forms with a violent course, the best method is the external opening of the sinus through the floor with a small bore. In the prolonged cases even the most radical procedures may be required regardless of the possible deformity. Two such cases are cited.

The discovery of antibiotics has changed the management of acute infections of the

upper respiratory tract. This, however, does not exclude surgical intervention when indicated in the individual case.

Morrison [148] calls attention to the wide variation in symptomatology from the violent acute exacerbation to the comparatively asymptomatic condition.

In the acute flare-ups antibiotics are helpful but may lull one into a sense of false security. These cases have to be watched carefully until the process has fully subsided or until the indications for surgery are clear.

The asymptomatic cases are usually discovered by chance in routine x-rays, and are often associated with a general pansinusitis.

Some cases with low-grade infection manifest few symptoms aside from a chronic discharge with crusting. These are usually associated with a chronic ethmoiditis.

In all chronic cases one must investigate the possibility of an allergic factor.

Irrigation is not always successful and may fail in nearly half the cases.

Dr. Morrison reviewed the various surgical procedures for dealing with chronic cases, and comments on the lack of unanimity among various surgeons as to how to deal with the nasofrontal duct.

A case of leontiasis ossium in a woman of 40, described by Auriti,[149] displayed marked involvement of all the sinuses. Although the features were not grossly disfigured, the x-ray pictures revealed marked density of the cranial vault, the floor of the anterior fossa, the malar bones, and mandible. The sinuses were all cloudy, the right frontal completely obliterated, the antrum very dark, and the ethmoids cloudy. The patient complained of profuse nasal discharge and obstruction and marked headaches. Under antibiotic therapy the discharge and obstruction were relieved, but the headaches persisted. Two operations were performed. The ethmoids were opened up and cleaned out, the antrums likewise, and the frontals were relieved of the excess bone through external incisions. There was no sinus cavity in one of the frontals, and the antrums were reduced to very small cavities by the encroaching bone.

Histologic examination of the bone showed a spongy type of bone with spaces filled with fat. Paget's disease and von Recklinghausen's disease were ruled out by the laboratory tests and examination of the tissue removed.

De Vido [150] had a case of cholesteatoma of the frontal sinus in a woman of 35. There was a history of having sustained trauma to the frontoparietal region at the age of 13, the immediate effects of which were minimal. Headaches appeared shortly after, which were not constant nor particularly severe. A swelling over the lateral frontal area appeared a few months prior to the patient's admission to the clinic. X-rays revealed a smooth area of bony absorption laterally over the frontal area, with sharply defined outline. The planigraph shows this very clearly. At operation the cavity was found to be filled with a greyish-white friable nonfetid material, which consisted of masses of dead cells, cholesterin crystals, and old blood. The cavity was lined with greatly thickened mucosa infiltrated with round cells.

The author presents a short discussion of the theories pertaining to the pathogenesis, mentioning Witmark, McKenzie, Kohler, Coates, and others.

Larger's case [151] was a woman of 35, who had suffered intractable hemicranial headaches for a period of five years. It came on following an acute upper respiratory infection and resisted all sorts of therapy applied on the theory that it was a case of neuralgia. Nasal examination, x-rays, and exploratory puncture of the antrum were all negative. However, it was noted that the middle turbinate on the affected side was hypertrophied and presented a slightly yellowish tinge along the olfactory border. The x-rays were repeated and revealed slight clouding of the ethmoid region.

The antrum was opened via the sublabial approach and found to be normal. However, on opening into the ethmoids through the antrum, pus and polypi were found extend-

ing through the labyrinth all the way back into the ethmoid. The patient was promptly and completely relieved of all symptoms.

Dixon [152] emphasizes the importance of a careful history relating to personal habits, environment, character of the discharge, time of appearance, relationship to seasons, etc. Also it is important to have a general appraisal of the cardiovascular and endocrine systems. Conservative therapy in the form of means to improve ventilation, such as vasoconstriction, removal of small polypi, and general antiallergic regimen, should be instituted.

If surgery is indicated he favors the intranasal procedures. All cases should be followed up with particular attention to recurring polypi. Dixon reports 75% of a series of 150 cases were cured up to periods of nine years.

### Trauma—Foreign Bodies

In a monograph that runs over 90 pages, Seiferth [153] discusses the effects of trauma to the nose, sinuses, and base of the skull. It is comprehensive, thorough, and covers every aspect of the subject. In respect to involvement of the sinuses in basal skull fractures, Seiferth states that although diagnostic problems are still complex, the general outlook is better than it used to be because of the accumulated experience of the recent war, the intelligent use of antibiotics and chemotherapy, and newer diagnostic procedures for intracranial conditions. Also, the friendly cooperation of otolaryngologists, neurologists, neurosurgeons, ophthalmologists, and roentgenologists during the war has resulted in more thorough coverage of these cases and better understanding all around. The combined knowledge and skill of these specialists covering overlapping fields has eliminated differing points of view and broadened the knowledge of all. However, he feels that skull fractures in which the sinuses or the auditory apparatus are involved should be handled in the otolaryngological service. Cases in which cerebrospinal rhinorrhea is present or the sphenoid bone is involved properly belong to the neurosurgeon. Skull fractures in combination with fracture of the upper jaw should be handled by the neurosurgeon in cooperation with the maxillofacial surgeon.

Therapy of cases in which the sinuses are involved should be conservative in certain cases, for instance, a basal skull fracture with a simple fracture line running through the sinus wall but without splintering of the bone and laceration of the dura, or a case of basal skull fracture with fracture of the upper jaw; these cases are rarely complicated by a meningitis. A third type in which conservatism is advised is the trauma due to a small penetrating body. The wound closes over rapidly, and in most cases infection can be controlled with antibiotics.

Surgical procedures comprise operations on the sinuses, the base of the skull and the sinuses, and intracranial procedures directed at repair of dural lacerations or trauma to the brain substance.

Fractures into the frontal and ethmoid sinuses associated with communication into the anterior fossa are of two varieties: one, the fronto-orbital and, the other, the fronto-ethmoid in combination with backward displacement of the bony nose. In both these types there is usually considerable damage to the cribriform plate and the floor of the anterior fossa, with damage to the cura. These cases call for wide exposure, ablation of the frontal and ethmoids, and repair of the dura. When the nasal organ has been driven backward into the ethmoid space, both sides are involved and a careful search must be made for displaced fragments of the cribriform plate and ethmoid roof. In either type of injury the important thing is to repair the dural defect and seal off the sinuses against possible infection from the nose.

Complications such as hemorrhage, laceration of the dura, pneumatocele, and meningitis are discussed and typical cases cited along with some very good x-ray pictures.

The article is a classic and is topped by a complete bibliography from 1928 to date.

Collins,[154] discussing injuries of the nose and upper jaw, offers some pertinent comments on the treatment in cases where the sinuses are involved. With reference to the maxillary sinus he states that radiologic appearance of cloudiness does not necessarily indicate infection, since accumulated blood will give the same appearance. Antrum lavage is not indicated and may even be contraindicated. It is better to rely on the clinical signs when one suspects an infection. In cases where the antrum has to be packed for the support of a malar fracture, he recommends bringing the packing into the nose via an infraturbinal opening so that the alveolar incision may be immediately closed.

A frontal sinus fracture involving only the anterior wall may be left alone, or if the bone is depressed it may be elevated into position with a septal elevator. If the posterior wall is fractured, one must consider the possibility of a dural tear and cerebrospinal rhinorrhea. If these are unrecognized subsequent infection of the sinus may lead to serious intracranial complications. The question as to whether the neurosurgeon should operate with a possible tear cannot be answered categorically, since each case must be assessed on its individual merits.

In severe, compound comminuted fractures of the frontoethmoid region, experience has proved the value of prompt sealing of the dural laceration by one means or another. The question as to whether the sinus mucosa should be exenterated is one on which there is still some disagreement. The tendency lately, however, with which the author agrees, is that the sinus mucosa should not be disturbed providing it is not infected and providing that adequate drainage into the nose is effected. If the mucosa is removed and the sinus not obliterated, the new lining will certainly not be as good as the normal mucosa. Besides, in many cases it is difficult to obliterate the sinus without a resulting deformity. Treatment of the sinus, therefore, in uninfected cases, should be limited to careful removal of bone fragments which have no chance for survival, establishment of adequate drainage into the nose, and proper use of antibiotics by instillation as well as parenterally.

Gutmann [155] reports a case of a woman of 48 who fell downstairs, fracturing her coccyx. She was unconscious for six hours and lay in a plaster cast for five weeks. X-rays showed no skull fracture. Prior to the accident the patient had suffered from perennial rhinitis and sinusitis for years, and had resisted all therapeutic measures directed to an allergy in which all skin tests were negative. Her blood eosinophil count averaged 8%-15%, and the nasal secretion was persistently alkaline (pH 8.3). After the accident the count dropped to 3% or 4% eosinophils and the nasal secretion was reduced to a pH of 7.8. Also up to 18 months following the accident the patient was completely relieved of all nasal symptoms.

The author theorizes that relief may have been due to the action of ACTH liberated in consequence of the stress condition induced by the trauma. He concludes by asking the question, "What really occurred in this patient?"

Tupin [156] describes the course of an interesting case in which the patient, an officer aged 21, sustained a skull fracture, from which he recovered. However, during the next two years he suffered three attacks of a pneumococcic meningitis which were apparently controlled by antibiotic therapy. Following the last attack he began to manifest epileptiform seizures. X-rays revealed a fracture through the vault, extending down to the internal angle of the frontal sinus. It was difficult to determine to a certainty whether the lesion involved the right or the left side. Planigraphs seemed to point to the right side. The right frontal was opened and a star-shaped fracture found in the posterior wall at the apex, of which there was "un veritable enfoncement en touche de piano." The mucosa, slightly edematous, was lightly curetted; likewise the margins of the fracture. The osseous breach was filled

with Horsley's wax. Apparently the patient recovered.

However, he returned after a lapse of almost two years, stating that he had been well for over a year, but in recent months had begun to have a nasal discharge, which was shown to be cerebrospinal fluid and again a pneumococcic meningitis. X-rays showed the tract of the fracture now seemingly in the posterior wall of the left frontal. The area was exposed, revealing a gaping fissure in the region of the external angle, from which the cerebrospinal fluid was escaping freely. Also, another fissure was found at the superointernal angle. Again these cracks were sealed with Horsley's wax. The maneuver was difficult because of the steady flow of liquid. However, by using a sufficient quantity of the material it was finally possible to completely seal the cracks. Up to two years following the last procedure the patient was reported to be without symptoms.

The author claims that the wax, being a foreign body, stimulates a local reaction leading to the formation of fibrous tissue which permanently closes the gap.

Another case in which Horsley's wax was successfully employed is reported by Piquet.[157] The anterior wall of the frontal sinus was bashed in, as was the nose. At operation it was found that the bone was comminuted, the mucosa torn, and a fracture line was seen in the posterior wall exuding blood. Loose bony fragments were removed along with the torn mucosa; bone still attached to periosteum was carefully replaced and then the entire cavity was filled with Horsley's wax, which helped to support the loose fragments and restore the contour.

The postoperative course was uneventful, and a satisfactory cosmetic result was obtained.

Work,[158] reporting 12 cases of trauma involving the frontal sinuses, emphasizes the importance of the initial treatment of the sinuses at the time the wound is debrided. If the patient's condition at the time does not permit surgical exploration, this should be done at the earliest possible time thereafter. Late complications can thus be avoided.

The author favors ablation of the sinus as the method of choice, having employed it successfully in 84% of his cases. Exenteration of the ethmoids should be done at the same time. In two cases where ablation was not done, the nasofrontal duct was kept patent by the frequent use of an acrylic dilator.

Absorbable gelatin sponge (Gelfoam) was found to be successful in plugging dural leaks.

In the case reported by Dincer[159] the patient died in coma 47 days after having sustained a severe trauma in the frontal region. Despite the fact that x-rays revealed a fracture involving both tables of the frontal bone and a definite cerebrospinal rhinorrhea, no attempt was made to repair the dural laceration, although it was planned after the patient was removed to Istanbul. During the interim he was treated by bed rest, antibiotics, and intravenous dextrose and magnesium. A temporary remission of the symptoms permitted the patient to go home, whence he returned shortly thereafter with symptoms of meningitis. Spinal tap, x-rays, and encephalogram all pointed to a dural laceration and pneumoencephalus, but surgery was delayed until it was too late. Autopsy revealed two linear fractures through the frontal bone, fracture of the zygoma and maxilla, suppurative sinusitis, meningitis with dilated ventricles. Pneumoencephalus was presumed to be present but not proved.

Hirsch[160] submits the clinical history and autopsy report of a case of delayed intracranial complications almost three years after a basal skull fracture. The patient, a 13-year-old boy, had been symptom-free until headaches appeared, followed by unilateral convulsions of face, shoulder, and arm. Temporary relief followed antibiotic therapy, but some generalized convulsions supervened and the clinical signs all pointed to extensive intracranial pathology.

The autopsy findings included old transverse fracture of the anterior portion of the

right orbital plate of the frontal bone, chronic purulent right frontal sinusitis, chronic purulent basilar meningitis, large abscess in both frontal lobes.

This case again demonstrates the danger of latent infection becoming activated following a basal skull fracture. These are particularly likely to occur if the fracture line runs through the cribriform plate or one of the sinuses.

The case reported by van Dorp [161] was in a man of 32, a mechanic who was injured by a ballrace retaining surclip, one end of which penetrated the upper lip at the junction of the philtrum and external nares, passed laterally and backward between the mucosa of the nasal floor and hard palate, entering the antrum, where the end of the curved clip arched upward and forward, coming to rest below the floor of the orbit in the apex of the antrum. X-ray pictures of the patient with the foreign body in situ, as well as pictures showing the clip similiarly placed in a skull, reveal this very unusual phenomenon. The clip was removed under general anesthesia after being filed through so that the terminal portion could readily be extracted without damage to the orbit or soft tissues of the face.

Perier and Gresly [162] report a case in which one root of an upper molar was lost in the antrum at the extraction. X-rays showed it to be located in a recess posteriorly, lying horizontally with the apex pointing backward. When the sinus was opened via a Caldwell-Luc, the following day, the tooth root could not be found. It was only after the bony breach had been widened sufficiently to permit access to all the recesses of the sinus that it was found high up in the anterior superior part of the sinus.

The lesson which the authors wish to relay is this: Be sure to take a picture immediately prior to the operative intervention.

### Miscellaneous

Williams [163] discusses the various types of headache encountered in everyday practice and offers some pointers in differential diagnosis. Superficial pain is tight and sharp and is located at the site of irritation. Deep pain is persistent, aching, associated with drop in pulse rate and blood pressure. It is due to irritation of deep structures such as muscle and blood vessel and is experienced in areas remote from the site of the pathology. Neuralgias are spasmodic, sharply intense, intermittent, and referred along the distribution of nerves.

Fibrositis of the nuchal muscles produces superficial pain often relieved by mild exercise, and aggravated by excessive movement.

Sinus headaches are acute and vary with the degree of engorgement of the mucous membrane and are relieved by drainage.

Attention is directed to the differential diagnosis between migraine and histamine cephalalgia. The former begins at an earlier stage of life, is characterized by prodromal aura, and can be precipitated by excitement, fatigue, hunger, menstruation, etc. Histamine cephalalgia comes on a little later in life, is sudden in onset, frequently occurs during the night, is worse on lying down, and can be precipitated by the taking of alcohol. It is usually associated with evidence of cholinergic overaction, such as nasal congestion, discharge, and lacrimation.

A most interesting case reported by McCallum [164] had to do with a 31-year-old man who started with chills, sweating, and general malaise, followed shortly after by tenderness and swelling of the antrum. Biopsy of a mass presenting on the septum revealed a granuloma. Despite energetic antibiotic therapy and cortisone, the patient went from bad to worse, with symptoms of malaise, anorexia, sweating, fever, and pains in the joints and muscles. He died at the end of nine weeks, and autopsy disclosed periarteritis nodosa affecting the renal and pulmonary vessels. "The pathologic features of the case correspond to the hypersensitivity angiitis described by Zeek [165] rather than the classical type of periarteritis nodosa."

The author states that three cases of like nature have been reported, all of which

ended fatally despite surgical intervention. However, the author believes that if the focus were radically extirpated early in the disease, the extensive involvement of the vessels might be halted. Several authors have referred to hypersensitivity in these persons, manifested previously in other forms, which may have predisposed them to bacterial hypersensitivity when exposed to the right pathogen.

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# Society Transactions

## AMERICAN LARYNGOLOGICAL ASSOCIATION

**Bernard J. McMahon, M. D., President**
**Samuel Salinger, M. D., Abstract Editor**
**Harry P. Schenck, M. D., Secretary**
**Scientific Sessions, Quebec, Canada, May 13-14, 1956**

### Humidity, a Problem in Air Conditioning.

DR. ARTHUR W. PROETZ.

To provide adequate relative humidity in the dwelling or office to satisfy the needs of the nasal mucosa is a problem that is not easily solved. With the optimum being between 40%-50%, one finds that central heating usually depresses the humidity to a point at which the mucous blanket becomes scanty and viscid and ciliary action is slowed down. Figures assembled by Proetz from 19 cities during the month of January reveal an average outdoor humidity of 70% and indoor humidity of 23%. Even though the humidity can be raised to the necessary level within 30 minutes to 2½ hours, depending on the apparatus employed, it would soon fall rapidly due to losses through open doors, window cracks, and even the walls themselves. Consequently the humidifying agent has to be kept going. Pans of water on the table or radiator are worthless. Commercial steam or cold vaporizers are somewhat better but not so effective as a teakettle on a gas flame.

As to humidity indicators, the sling psychrometer has been found to be the most reliable.

Central furnace type of humidifiers have certain drawbacks arising from the dust which is scattered throughout the house. Unless means can be found for filtering the water this type of vaporizer leaves something to be desired.

#### Discussion

DR. LAWRENCE R. BOIES commented on the amount of valuable data assembled by Dr. Proetz on a very important subject. Although a practical solution of the problem of humidity control is still unavailable, it is comforting to know that the effort will continue to be made. Raising the humidity for therapeutic purposes has been satisfactorily accomplished in the management of acute laryngotracheitis in children. Dr. Boies has also found it practical to employ a humidifier in the postoperative care of patients whose nasal passages have been packed for a period following surgery. Thus it is shown that humidity can be controlled in restricted areas in the care of the sick. If this could be extended satisfactorily to the home and the environment where people work, much would be accomplished in the prevention of the common cold and respiratory affections.

DR. EDWIN N. BROYLES called attention to the plight of laryngectomy patients who suffer from dried mucus and crusting in the trachea during the winter months only. This proves the point brought out by Dr. Proetz as to the necessity of maintaining adequate humidity in the environment.

DR. THOMAS C. GALLOWAY called attention to the fact that low humidity in the Rocky Mountain area is well tolerated, whereas in the Middle West the same degree of humidity in the home is unhealthy. The explanation for this phenomenon may be in the dust factor which is present in the dry house. He inquired as to whether Dr. Proetz had an opinion on this point.

DR. PROETZ, in closing, offered as his explanation of the point brought up by Dr. Galloway that the distribution of pathogenic bacteria in the higher altitudes is much lower than lower down, and cited Grenfel's expeditions into Labrador, where there were no colds among the natives during the season when no ships arrived. Promptly, however, after these newcomers were landed, a severe epidemic of colds broke out among the natives with a number of deaths due, in all probability, to their inability to handle the bacterial invaders.

Dr. Proetz mentioned a very simple indication of too low humidity in a room, namely, the drawing of sparks when contacting objects.

### Histamine-Releasing Drugs.

DR. F. C. MCINTOSH (by invitation).

The human body contains approximately 300 mg. of histamine concentrated mostly in mast cells along with heparin. Its action is threefold, namely, contraction of smooth muscle, increased gland activity, and heightened capillary permeability. A wide variety of drugs is listed which are, to greater or less degree, histamine liberators. These include quaternary salts, morphine and other alkaloids, chemotherapeutic agents, circulatory drugs, sympathomimetic drugs, protein hydrolysates, basic amino acids, and others. They seem to act through their affinity for the heparin stored

within the mast cells. When a sufficient concentration has been reached the histamine-containing granules in the cell are lysed.

The relationship between the allergic or anaphylactic release of histamine and the release of histamine by drugs is a matter that has as yet not been satisfactorily explained. The author speculates that in the allergic reactions the antigen-antibody reaction may trigger some enzymic reaction leading to the formation of basic or polypeptide histamine liberators. "It is conceivable that by the local application of a histamine liberator a sensitized tissue could be depleted of its histamine stores for a long period, for instance the season for a particular pollen; the antigen-antibody reaction to the allergen could then still take place, but would have fewer unpleasant consequences. The sudden unloading of the histamine depots would produce a severe reaction, but this could presumably be controlled with antihistamines and adrenalin."

The investigations conducted by the author and others are doing much to explain untoward reactions to certain drugs and point a way to avoid or overcome them.

### Discussion

Dr. Aubrey G. Rawlins reviewed the facts about histamine, its locale within the body, and its physiologic action. One striking characteristic of histamine is its potentiality as a powerful endogenous agent capable of producing drastic physiologic and pathologic effects, yet under ordinary circumstances devoid of physiologic significance. Dr. Rawlins commented on the versatility of the mast cell and the various functions attributed to it by physiologists, such as its response to stress, its role in the production of ground substance of the connective tissue, its heparin-like polysaccharide which may act as an inhibitor of hyaluronidase, and now the storage and release of histamine, as described by the essayist.

He submitted the question as to whether antihistamine drugs act as antihyaluronidase factors and whether hyaluronidase as well as histamine is liberated in cell damage, and plays an active part in inflammation. Also, will hyaluronidase liberate histamine?

Dr. Sam E. Roberts inquired as to whether there is any synergistic action between heparin and histamine when given concurrently by intravenous infusion or are they antagonistic.

Dr. McIntosh replied to Dr. Rawlins' question to the effect that he knew of no evidence either for or against the activation of hyaluronidase in mast-cell disintegration. In general mast cells do not survive very long in any real inflammation, although in mild chronic injuries they tend to increase in numbers. Histamine release is not of any importance in the maintenance of inflammation because this release occurs explosively, if at all, and it takes a long time for the histamine to be put back in the tissues, and the duration of action of released histamine is so extremely short that the whole thing is over and done with in hours at the most and cannot happen again for a long time.

It is possible that hyaluronidase is activated as a result of mast-cell disintegration and is a subject worthy of further investigation.

As to Dr. Roberts' question, there is no appreciable synergism or antagonism between histamine and heparin. However, the histamine liberators form an insoluble complex with heparin, and heparin is a moderately active antagonist to the histamine liberators. It would be desirable if one could find a heparin analogue that might be more effective in this respect and still not have too much effect on blood clotting. Thus far such an ideal compound has not been evolved.

**Otolaryngologic Aspects of Hypometabolism.** Dr. Jerome A. Hilger.

Hypothyroidism in various degrees may be the basic etiologic factor in a wide variety of otolaryngologic conditions. The following are a few in which thyroid therapy has proved successful as demonstrated in typical cases cited: chronic vocal cord edema, post-thyroidectomy paresis and edema, chronic nasal obstruction with discharge, tubal catarrh, recurring serous otitis media, mucoproteinous edema of pharyngeal tissues, vascular head pains, and endolymphatic disorders. The diagnosis is reached through a careful history and proper laboratory investigation. Since the BMR test is not always reliable, it has been found that the radioactive iodine uptake is more dependable. Values of 5% and below are definite indications of hypothyroidism. Where available the most accurate test is the determination of the serum protein-bound iodine.

Emphasis is laid on the importance of bearing in mind the possibility of thyroid deficiency in many of our otolaryngologic conditions where multiplicity of symptoms and chronicity and resistance to routine therapeutic procedures are dominant features.

### Discussion

Dr. Francis W. Davison supported Dr. Hilger's thesis by citing three pertinent cases. One patient demonstrated the fact that hypothyroid patients can be quite thin. In this case, hoarseness, nasal obstruction, and perception deafness were all due to low metabolism. The PBI was 2.34γ as against a normal of 5.3. Two grains (0.12 gm.) of thyroid extract daily brought relief in about three weeks. In another case hearing difficulty due to

middle-ear effusion yielded to thyroid therapy despite the fact that the BMR was only −6.

Another patient, who was obese, also had recurring hearing loss due to middle-ear effusion. This patient was followed for 12 years and always suffered a recurrence of the ear complaint when she discontinued the thyroid.

Dr. Davison has noted that subthyroid patients usually like a room that is superheated.

Dr. Lewis F. Morrison called attention to the semantic aspect of this matter, since there is a difference between hypothyroidism and hypometabolism. It is erroneous to assume that normal limits are between −10 and +10. This was proved in an experience with patients who were hospitalized for five days with BMR of −4 or −3, but who after several days showed −23 to −35. Dr. Morrison is opposed to the empiric prescription of supplemental thyroid therapy and warns against this practice without suitable laboratory guidance.

He asked Dr. Hilger why the serum cholesterol determination was not mentioned.

Dr. James M. Robb suggested that thyroid therapy be under the supervision of the otolaryngologist rather than the internist, since the former is in a better position to evaluate the status of the auditory apparatus as well as the nasal passages and the larynx.

Dr. Hilger, in closing the discussion, pointed out that these patients are not putty-faced persons as a rule. The PBI determination is a satisfactory guide to therapy and should be followed because there is no dogmatic rule governing the optimum dose for each person.

He agreed with Dr. Morrison that the BMR is inadequate and misleading, and frequently poorly done. If facilities are not available for a PBI determination it is a simple matter to send a specimen of the patient's blood plasma to any number of well-equipped laboratories and obtain a reading in a matter of a few days.

The matter of serum cholesterol determination was purposely omitted because it is only additive information and the day was too nice to be spent in superfluities! It is merely a confirmatory test to the BMR and if reported normal leaves one unconvinced.

Dr. Hilger appreciated Dr. Robb's suggestion that the paper be read. In this instance one could come abreast in a short time of what took him much longer to assemble. The endocrine system is amazingly important in our field, much more so than in internal medicine. Otolaryngologists have the opportunity of making the primary diagnosis more frequently than in any other branch of medicine.

The point brought up by Dr. Morrison relative to the distinction between hypothyroidism and hypometabolism is well taken. He deliberately chose the title of hypometabolism and attempted to show that there is a hypothyroid hypometabolism or a thyrotic hypometabolism, but also a hypopituitary and a hypothalamic hypometabolism, as well as the hypothyroid type. Hypometabolism may be related to hypothyroidism, but all hypometabolism is not due primarily to hypothyroidism.

**Functional Diseases of the Nose.** Dr. Stewart Nash.

(No abstract submitted.)

**Unusual Virus Diseases in Otolaryngology.** Dr. P. E. Ireland and Dr. T. J. Molony.

Virus disease seems to be on the increase and presents a wide variety of manifestations, a number of which are classified by the authors. More in detail and relating particularly to the field of otolaryngology are the A. P. C. viruses, cat scratch fever, and atypical pneumonias. The adenoidal-pharyngeal-conjunctival virus was found to be mildly epidemic. In a Toronto epidemic, apparently originating and being spread from swimming pools, a virus was recovered in several cases which was grown in tissue cultures of monkey-kidney epithelium or "Hela" cells.

Several cases of cat scratch fever were described, and emphasis was laid on differentiating the condition from mononucleosis, tuberculosis, Hodgkin's disease, tularemia, rheumatic fever, etc. The cat scratch skin test is done by injecting 0.1 cc. of an antigen of known potency intradermally and noting the reaction after 48 hours, a positive reaction being the appearance of at least 5 mm. in diameter with an erythema of at least 10 mm. in diameter. The clinical course of the disease is described and typical cases cited.

The authors found an increased incidence of atypical pneumonias in areas where poultry raising was a prominent industry. Pigeons and turkeys were very abundant in a certain five-mile radius where these virus pneumonias were prevalent. It is hoped that further studies may identify the virus in turkeys and prove its transmission to humans.

**The Virus Theory of Nasal-Polyp Etiology and Its Practical Applications.** Dr. Francis L. Weille and Dr. Robert S. Gohd.

In an attempt to prove that a virus is responsible for the development and recurrence of nasal polypi, Weille and Gohd conducted a number of experiments in which polypi fluid was injected into the allantoic fluid of the chick embryo. This was found to result in increased proteins in the fluid. Passage of this fluid through successive chick embryos produced the same changes through five successive passages, although a diminution in the virulence was noted beyond that point. This

would seem to support the thesis that the infective agent was transmissible. However, in order to fulfil the last of Koch's postulates, namely, to reproduce the disease in susceptible animals, attempts were made to produce gross or microscopic tissue changes in the nasal mucosa of experimental animals, all of which failed.

However, the presence of a specific antibody concentration in the serum of polyposis cases and its absence in controls might be considered legitimate and important evidence. Studies will continue along the lines of devising a serological test to prove its existence.

The theory of virus etiology in polyposis, if fully proved, could well explain many of the manifestations of polyp growth, recurrence, and frequent disappearance following diathermy to the stumps, suggesting destruction of the intracellular viral agent.

### Discussion

DR. LEWIS F. MORRISON found that the common ground for discussing these two papers lays in the term "virus." He noted that no mention was made of the possible role of a virus in the etiology of laryngeal papillomata. He could not quite agree with Dr. Ireland about our present knowledge of viruses, which even in the opinion of virologists is quite meager. The points brought out with reference to the role of a virus in upper respiratory affections (adenoidal, conjunctivoadenoidal) and the probable etiologic connection with the swimming pool are well taken.

Concerning the intradermal antigen test, there is a possibility always that the virus may not be sufficiently attenuated. Possibly the essayist may have more to say on this point.

The matter of turkey droppings as a contaminant in an area with a high incidence of atypical pneumonia seems to be a very practical consideration.

As to Dr. Weille's theory, it sounds convincing but perhaps only because nobody is in a position to intelligently refute it. Dr. Morrison felt that he could not quite divorce himself from the conviction that the allergic factors are more important than the virus. Since polyps are found in the mucosa of other organs than the nose, it would appear difficult to apply Dr. Weille's theory widely enough to cover all situations. As to the disappearance of polyps following postexcision diathermy being due to heat killing the virus, it must be remembered that any tissue insult may be a factor in remission.

Fundamentally, Dr. Weille's work is most commendable. It is regrettable, however, that he was not rewarded by the discovery of a specific virus that could be readily identified.

He asked Dr. Weille whether the allantoic fluid had been centrifuged and examined under the electron microscope for the possible identification of a virus.

Dr. Morrison called attention to the analogy between laryngeal papilloma and rabbit papilloma, in which a large virus was identified which is sensitive to tetracycline and oxytetracycline (Terramycin).

DR. IRELAND replied to Dr. Morrison's query bearing on the potency of the antigen used in the skin test. The antigens are made from material taken from the so-called pustule, and, since the virulence is variable, it is better to take material from several lesions. As for turkey disease, he admitted that efforts at control were disappointing because of lack of cooperation on the part of the large packing companies in control.

Dr. Ireland paid tribute to his associate in the presentation, Dr. Terence Molony, who did a great deal of the work in its presentation.

DR. WEILLE stated that in the staff meetings at the Massachusetts Eye and Ear Infirmary the privilege of becoming as violent as one pleased was accorded to all. It can therefore work both ways. Concerning Dr. Morrison's comment relative to the cause and effect of diathermy in the polyp cases, Dr. Morrison failed to offer any alternative explanation to the one submitted by himself.

As regards allergy in relation to the etiology of polyps, rather than a virus, there are many people who do not believe that allergy has anything to do with polyps. It is true that the majority do believe in this relationship, but is it not possible that the allergy creates the basic immunologic response to the virus in the same way as hemolytic streptococci? Vaccines are still in vogue at certain centers, and there are those who are convinced that the immunologic responses to viruses are similar to those of the ordinary bacteria.

As to the use of the electron microscope, Dr. Weille's virologist has one available whenever he feels that it is necessary. However, up to the present he has not deemed it essential.

Mention was made of skin tests. These were tried, but without results. Since it is assumed that the antibody is the reagent resident in the skin mass, it is possible that a more thorough investigation along the line of the alphabetical A. P. C. notation by Hubner and other workers might evolve a dependable serologic test. Also if a few volunteers could be found it might be possible to produce polypi in the nose experimentally.

**Management of Nonmalignant Growths in the Maxillary Sinus.** DR. O. E. VAN ALYEA.

Polypi and cysts are the commonest nonmalignant growths found in the antrum. The former

develop oftenest in the vicinity of the ostium as a result of irritation, which may be an allergy or a pathogen from infection. They may grow into the sinus cavity or out of it through the ostium, appearing in the middle meatus or even growing backward into the choana.

Cysts may be either the simple mucous type or may originate from the dental appendages in the form of radicular or follicular cysts. Frequently they are symptomless but at times may be responsible for local numbness, nasal congestion, and frontal headaches.

Diagnosis in all cases can readily be made through the use of contrast media with x-rays. Most cysts are found in the floor of the antrum or the lateral walls, and are usually smooth and almost spherical in outline. Polypi, on the other hand, are more irregular in outline and commonest along the vasoantral wall. If they cannot be controlled by antiallergic therapy they should be removed via a sublabial approach. The antrum mucosa is in most cases left undisturbed.

Cysts may at times be eradicated through an intranasal antrostomy, although in many instances it is necessary to resort to the Caldwell-Luc operation because of their location and size.

### Discussion

Dr. Robert Goodale emphasized the point that cysts of the antrum are not to be ignored or minimized, particularly if the patient has symptoms referable to the one side. He cited a case of uveitis which failed to respond to therapy until an apparently simple cyst of the antrum was removed, revealing pus and a predominantly pneumococcus infection. Too much reliance should not be placed on the antibiotics when infection is present along with a cyst.

Polypi and cysts are common findings. Dr. Goodale favors the removal of polypi developing within the antrum via the canine approach. It is not necessary to remove the mucosa entirely. The surgery should be limited to the presenting pathology. Additional drainage through an inferior meatus opening is not always necessary. He agrees with Dr. Van Alyea that the possibility of malignancy in all these cases should never be overlooked. All material removed should be sent to the pathologist.

Dr. Lewis F. Morrison inquired as to the presence of organisms in the cysts. Previous reports on this item have been contradictory.

Dr. Robert S. Priest wanted to know whether Dr. Van Alyea feels that surgical exploration is indicated in all cases of cysts. He has had the experience of passing up some of these benign growths only to have the patient return complaining of pain and subsequent biopsy revealed mixed tumor.

Dr. Van Alyea replied to Dr. Morrison's query by stating that cultures have been done routinely but that he had no significant report to offer. Besides, in many cases the cyst was opened via the intranasal route, often merely as a result of antrum irrigation.

**Experimental Treatment of Recurrent Carcinoma of the Nasopharynx with Electrodesiccation, Radioactive Cobalt, and X-Ray Radiation.** Dr. Francis A. Sooy.

Six cases of recurring inoperable carcinoma of the nasopharynx previously unsuccessfully treated with irradiation were reported by Sooy. These were treated by electrodesiccation and local intranasal radiation with radioactive cobalt. The greater part of the septum was removed to afford more space for the transnasal manipulations. Three of the patients were alive and free from signs of recurrence more than six years following therapy. Subsequently 10 additional cases were similarly treated, with 5 of them surviving for periods of from six months to four years.

Cases showing clinical or x-ray evidence of extension into the base of the skull were excluded.

The electrodesiccation was carried out with caution, lest excessive heat cause damage to the pituitary and optic nerves.

The radioactive cobalt was applied at 1 cm. distance from the area, via a Foley urethral catheter, the bag being distended with radiopaque solution to permit accurate placement of the cobalt. The dosage administered was 4000 to 6000 r.

Although considerable dryness was observed, there was very little crusting after the initial slough and sequestra had been removed.

### Discussion

Dr. Harry P. Schenck felt that this presentation teaches us not to be too pessimistic about some of these malignancies. He has always felt that electrocoagulation was not employed widely enough in otolaryngological practice. One reason may be the fact that local anesthesia often limits the extent and degree of the coagulation as compared with the freedom afforded under general anesthesia.

Concerning the freedom from crusting following removal of the septum reported by the author, Dr. Schenck feels that there must be some difference in the influence of climate, because the cases he has seen in Philadelphia manifest marked crusting for months.

The low incidence of metastases in the cases reported is rather striking in view of the size of the primary lesions. In his cases, he has not been so fortunate.

The advantage of the technique described is obvious, since it affords a wide approach to all the affected area.

In this connection, Dr. Schenck suggested that this procedure need not be restricted to carcinoma alone. He had had a good result in an extensive chordoma with destruction of the sella turcica by wide electrocoagulation applied through both sides of the nose as well as behind the palate. He did not destroy the septum.

Dr. Thomas C. Galloway has for many years been enthusiastic about the use of electrocoagulation.

It is important to know something about the character of the tumor, many of them being lymphoepitheliomas or transitional-cell carcinomas, both very malignant with early involvement of the glands. He noticed that the authors used x-ray therapy in some of these cases and wondered how much of the good result might be attributed to this medium rather than the cobalt. Removing the septum to afford an approach to the tumor impressed him like Lamb's story about the Chinaman who burned a house down when he wanted a roast pig.

He had found it practical to use Dr. Mosher's old incision, modified by a trap door through which the carcinoma involving the frontals, antrums, and sphenoids could be completely visualized and destroyed. Also at times it is just as feasible to approach the area via a transpalatal incision.

It was his impression that tumors arising from the septum were usually of the squamous-cell type, being less malignant and more effectively destroyed by a less mutilating procedure.

The outlook for the more malignant types is not as dark as previously considered. He has had the good fortune of seeing some of these cases cured in recent years, and considers the combined use of electrosurgery and radiation as being responsible. He assumes that the essayists were using the biterminal electrodes, which penetrate more deeply than the superficial desiccating current.

Dr. Sooy replied that their desiccating unit is adjusted to achieve a slough of about 1 cm. of bone and mucosa.

The transpalatal approach was considered but rejected in favor of the one described, because they wanted to preserve a wide aperture for inspection of the site in the postoperative period.

In addition to the symptoms of nasal obstruction and bleeding and cervical metastases, they frequently found early indication of the growth in the ear symptoms, such as unresolved serous otitis media. In three cases a prophylactic biopsy in Rosenmüller's fossa yielded positive evidence of lymphadenoma.

**Ciliary Streaming Through the Larynx and Distribution of Laryngeal Epithelium.** Dr. A. C. Hilding.

Studies were made of the distribution of squamous and ciliated epithelium in five human larynges removed at autopsy and in a number of recently killed calves. The results corresponded to the generally accepted pattern, except that above the vocal cords the squamous epithelium is apt to occur in islands or peninsulas, surrounded by ciliated columnar epithelium. Further observations on the pattern of ciliary streaming seemed to indicate two streams coming up from the trachea. The posterior one passes between the arytenoids to the rim of the larynx. The anterior one is split at the squamous-cell barrier of the cords into two parts flowing backward beneath the cord to the arytenoids.

The absence of ciliary currents in certain areas of the vocal cords seems to suggest a predisposing factor in the occurrence of carcinoma on the cords in 80%-85% of all malignancies of the larynx. Whether the inhaling of cigarette smoke or other noxious vapors in the atmosphere is as important an etiologic factor as other factors such as vocal trauma, etc., is a matter that requires further study and analysis.

**Discussion**

Dr. G. Edward Tremble mentioned the statement found in most standard textbooks that the mucous membrane of the human larynx varies according to the functions performed, thus, the difference between the squamous epithelium of the true cords and the ciliated columnar types with goblet cells in other areas. It is important to remember that the interarytenoid space contains both types of epithelium. When the arytenoids approximate the tissue between them is thrown into folds, the ridges being covered with squamous epithelium and the valleys with columnar ciliated. Nature has provided a similar arrangement in the nasal mucosa. Dr. Tremble described the ciliary streams coming up the trachea, the posterior one going directly to the interarytenoid space and the anterior passing below the cords to reach the same area. Convergence of the streams at this point probably explains the high incidence of tuberculous lesions in the posterior portion of the larynx.

Dr. Tremble has used dicalcium phosphate powder, which turns bright-orange color when in contact with moisture and serves as a good guide in determining ciliary streaming. The powder thus applied in the trachea seems to follow a spiral rather than a straight course, which may be due to the movements of the trachea in respiration.

Dr. Arthur W. Proetz was impressed by the finding described by Dr. Hilding where the ciliary

stream causes material to accumulate in the center just below the cords before spreading and passing posteriorly. This is just the area where subglottic lesions develop which are frequently overlooked.

However, it must be noted that in the specimens observed by Dr. Hilding the cough phenomenon was absent, of course, so that one cannot precisely evaluate the results. He would like to see this part of the investigation carried on with this reflex in mind.

The point brought out by Dr. Hilding regarding the mucous anchors of thick mucus coming out of the glands, and their influence in retarding the movement of the mucous blanket, ties in with his own observations on the effects of altered viscosity on this function, often the result of inadequate humidity and at times the result of limited thyroid activity, as pointed out by Dr. Hilger.

Dr. Proetz was wondering what happened to the spiral phenomenon described by Dr. Franklin of London and just mentioned by Dr. Tremble. It calls to mind the beautiful demonstration of spiral streaming in the sinuses which Dr. Hilding demonstrated some time ago.

Dr. Thomas C. Galloway inquired how fixed and persistent is the pattern of squamous and ciliated epithelium, and how much metaplasia occurs as a result of trauma, chemical irritation, etc.

Dr. Hilding called attention to differing predilection in sites between tuberculosis, which occurs more frequently in the posterior portion of the larynx, whereas carcinoma was commoner in the anterior. The facts are still not entirely clear.

Since these experiments were performed in dead animals, the findings would differ from those in the living because of the absence of the respiratory movements and changes in dimensions. Spiral streaming was not observed in these animals. However, in one human trachea which he obtained some months ago there was a very definite spiral flow.

Regarding the question brought up by Dr. Galloway, he could only infer from data obtained in similar experiments in the nose that the pattern of epithelium changes according to the stresses, normal and pathologic, which occur or are induced in the areas under observation.

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Dr. John A. Murtagh introduced Dr. Campbell, guest speaker, with whom he had been associated for 10 years in a study of the basic factors of the larynx and recurrent laryngeal nerve, and expressed his appreciation of his valuable contributions to the knowledge of the subject.

**Electrical Manifestations of Recurrent Nerve Function.** Dr. C. J. Campbell and Dr. John A. Murtagh.

A number of experiments were conducted on goats to determine the presence of mixed components in the recurrent laryngeal nerves. These nerves were dissected free in the anesthetized animals. "Stimulating electrodes connected to a Gross square stimulator and recording electrodes leading to a pre-amplifier, amplifier and cathode ray oscillator were placed on the nerve."

The nerve was crushed distally and the recordings of repetitive stimulation as traced in the oscilloscope photographed on a drawing board for enlarged tracings.

Much of the information thus gleaned pointed to the existence of proprioceptive afferent nerve elements from the laryngeal musculature. These investigations would seem to suppport the contention of Sherrington that motor nerves possess afferent as well as efferent fibers. The reciprocal inhibition shown by antagonistic laryngeal muscles adds further weight to this thesis.

The recordings were made at the peripheral end of the nerve, thus eliminating any influence from the tracheal and esophageal branches.

The experiments also appeared to demonstrate a double nerve supply to the cricothyroid muscle (superior laryngeal and recurrent).

**Discussion**

Dr. Louis H. Clerf speculated on the question as to how far one can translate findings in experimental animals to the human being. A case in point is the finding by one investigator of motor fibers distributed to the arytenoid muscle from the superior laryngeal nerve in man, whereas other investigators, failing to find these fibers in the dog, assumed the same to be true in man. It is of interest that pressure applied briefly to the recurrent nerve does not interfere with its conductivity. However, he suspected that remote effects would arise as shown in several patients operated upon for pulsion diverticulum who developed unilateral paralysis, apparently due to pressure of metallic retractors applied for 10 to 15 minutes.

Dr. Clerf was in agreement that one cannot rule out reflexes as a possible explanation of some of the results obtained in these and similar studies. They demonstrate that the degree of stimulation employed greatly influences the reactions, the interpretation of which is taken into account in the final analysis of the results.

While the question of proprioceptive elements in the muscles of the larynx has not been proved, having in mind the remarkable reciprocal relationship of the external ocular musculature and its similarity to the two halves of the larynx, it would

appear that further study of the end-organs in the laryngeal musculature is necessary.

Dr. Lewis F. Morrison stated that, in view of the variable types and numbers of bifurcations of the nerve in the neck, it might be of value to do the laryngectomies from above downward rather than the reverse. Also some knowledge might be gained by dusting some powder in the trachea and following its course while the procedure is being carried out.

He inquired of the essayists as to the formula for the amount of voltage employed and the duration of its application.

Dr. Campbell replied that if the facilities were adequate one might well repeat the experiment of Ogura and Aulenton in the superior laryngeal nerve stimulated in situ and following laryngectomy, using the extirpated nerve as they have done in the goat.

He believed that it is necessary to have square wave stimulators, the Grace instrument being the type he employed. Stimulus applied for 0.1 millisecond at one to three volts should be sufficient for most of the fibers. However, if one is desirous of observing the individual muscles the whole gamut of strength and duration would have to be used to get anything worth while.

Reverting to Dr. Clerf's point about the pressure, in his experiments it was applied for only a few minutes. Others have used pressure for longer periods and obtained a blockade of the function of the larger fibers. Lexal devised an instrument which would block out the largest fibers but retained function of the slower ones in the gamma group, but finally decided that just pinching the nerve between the thumb and finger for 30 to 60 minutes would accomplish the same thing. The time element is important, and it may be that significant data may have been missed by not carrying the experiment over a longer period of time.

Referring to another item mentioned by Dr. Clerf, he did attempt to examine the muscles to see if there were spindles present, which was not the case. However, they did take the precaution of examining the muscles in which everyone agrees that they are present. So the difficulty must have been with them and their present techniques, which he hoped would soon be improved.

**Submucosal Compartmentation of the Larynx.**

Dr. Joel J. Pressman.

The subject of this presentation was suggested to the author in his studies of the fate of radioisotopes injected into the larynx of experimental animals. It resulted in the observation that the submucosal area was divided into a number of compartments. Fluid injected in these spaces failed to pass from one to the other. Dyes were injected into certain areas of the larynx during the course of a laryngectomy and the distribution studied at the conclusion of the operation. Numerous colored slides were shown which demonstrated that the dye failed to cross the midline from one compartment to its opposite fellow. This applied to the epiglottis, vocal cords, ventricular bands, and arytenoids. The same results were obtained in similar experiments on the living dog. The direction of the spreading dye was studied in a variety of situations and demonstrated the areas and extent of the various compartments. These findings would seem to coincide with the results of Dr. Hilding's experiments on ciliary flow and also are in line with the distribution and direction of the lymphatics. They also suggest an explanation of the method of spread of carcinomas arising in various locations within the larynx.

**Discussion**

Dr. Paul H. Holinger brought up the point about the role of the small holes in the cartilage of the epiglottis as an avenue of escape for the fluid from one compartment to another, a matter that would have to be determined by the microscope rather than by gross appearance in view of their tiny caliber.

In some of the slides shown it appeared to him that the fluid did cross the midline, and he wondered whether it was due to the lymphatic distribution or perhaps an intracellular pick-up. He thought the compartments might be better delineated with fluid injected under a lesser degree of pressure. Considering the clinical interpretation of edema of the larynx, its favorite sites, and manner of spread, this is all understandable on the basis of anatomy, the phonating margin of the cord being tightly bound down and the subglottic area being loosely areolar. Also it is conceivable that the direction of the various muscles and their compartments may have much to do with the distribution of injected fluids.

It is of vital importance to recognize the role of the lymphatics in the spread of carcinoma in the larynx, which predispose certain areas to a carry-over from one side to the other.

Dr. Chevalier L. Jackson considered this presentation as another example of a new anatomical concept having considerable clinical significance. It impressed itself on him because of its analogy to the subject of segmentation of the lung, in which he has been deeply interested for some time. The clinical application of this newer knowledge of anatomy has had a direct bearing on the surgery of this organ. However, in the matter of the clinical application of Dr. Pressman's findings to the question of carcinoma of the larynx, it would be premature to apply them too

closely at this time, although the possibilities in other directions are quite evident.

Dr. Pressman agreed with Dr. Jackson in the matter of cancer in relationship to his experiments. Nevertheless, it is a subject to which some attention should be directed. Dr. Holinger's point about the spread of the dyes across the midline has merit because we know that structures such as nerves and vessels do pass from one side to the other, thus affording possible channels for spread. However, it should be remembered that the degree of pressure and the amount of fluid injected would have much to do with either the limitation within the compartment or its forceble spill-over into the opposite side.

This study has at least demonstrated to him in his work with radioisotopes that a mass injection in one space will not accomplish the results obtained when several spaces are injected.

**Cancer of the Larynx.** Dr. Fernand Montreuil (by invitation).

Analysis of a series of 70 cases of carcinoma of the larynx covering a period of three and a half years was presented by Montreuil. The cases were divided into three groups: intrinsic (confined to the vocal cord), extrinsic (within the laryngeal box), and extralaryngeal. It was pointed out that the symptoms were more dependent on the site of the growth than its size and extent. For instance, vocal cord lesions produce hoarseness in the earliest stages when the lesion is small, whereas in larger lesions away from the cords the disturbance of the voice may be delayed.

Direct laryngoscopy and biopsy are essential for diagnosis.

Because of the unpredictability of the virulence of various lesions, it is considered advisable to do a neck dissection in all cases of extrinsic and extralaryngeal lesions.

The author's experience with laryngectomy after extensive irradiation was not good, the wounds breaking down early with delayed healing.

Laryngectomy is usually done under local anesthesia except when preceded by tracheotomy or when neck dissection is contemplated. The T-incision is preferred, with removal of the hyoid bone and strap muscles. Early ambulation is encouraged.

### Discussion

Dr. Henry B. Orton prefers to classify his cases according to the anatomical site of its origin. A record of a series of cases which he presented at a recent meeting of the Academy showed that his best results following surgery were in the following order: cords, epiglottis, ventricles, arytenoid, subglottis, epiglottis and tongue, aryepiglottic fold, and pyriform sinus.

Dr. Orton called attention to one area frequently overlooked, namely, the vallecula, where exposure may be difficult if the epiglottis is close to the tongue. In these cases a transhyoid pharyngotomy will often spare the patient a total laryngectomy. Dr. Orton prefers general anesthesia because there is less shock to the patient when he realizes he can no longer talk. Also he prefers a U-incision, which affords better exposure.

Dr. Montreuil's operative mortality of 4% seems a little high in view of his own experience in 450 cases with a mortality of only 1.3%.

As for radiotherapy, he is averse to its use either preoperatively or postoperatively, because of possible complications, such as radionecrosis.

Dr. Francis E. LeJeune was interested in one item touched upon by Dr. Montreuil, namely, the possibility of implanting the carcinoma lower down in the bronchiopulmonary tract by way of the diagnostic bronchoscope. In this connection it is worth while mentioning the respect with which general surgeons treat the primary lesion, taking care that the knife and frequently the gloves used for the incision are discarded in favor of fresh ones.

Dr. Edwin N. Broyles inquired as to why the author fed his patients by intravenous injection rather than via an esophageal tube.

Dr. Montreuil agreed with Dr. Orton that various classifications of laryngeal carcinomas are frequently puzzling. It has been his policy to describe the lesion according to its exact location.

Concerning his reluctance to use a feeding tube, he was probably influenced by the fact that it causes the patient considerable discomfort both in the nose and in the pharynx. This was particularly true of the old rubber tubes. However, the newer polyethylene tubes are much less irritating and have been used by him in cases where tube feeding has to be carried on for some time because of a fistula.

**Benign Growths of the Vocal Cord: Clinical vs. Microscopic Diagnosis.** Dr. Samuel Salinger.

An analysis of over 250 consecutive biopsy specimens from the vocal cords yielded some interesting data from the point of view of comparing the preoperative clinical diagnosis with the microscopic findings. It was shown that the tumors which were definitely neoplastic, such as carcinoma, papilloma, etc., were generally recognized by their gross appearance and were confirmed by characteristic microscopic pictures. However, in the case of non-neoplastic growths the divergence was remarkable. Dr. Salinger found fault with the diagnosis of "vocal cord polyp" because in 81 cases so diagnosed not one was given such a designation by the pathologist. In a considerable number of

this group the growth was labeled "edematous fibroma" but the remainder covered a wide variety of conditions, which were named according to the predominant changes found in the various components of the tissue. The author is convinced that there is no characteristic histologic picture peculiar to the so-called polyp and that the term is therefore misleading, since it implies a definite entity, which it is not.

### Discussion

Dr. Francis E. LeJeune called attention to a description of polyp pathology in Coates, Schenck, and Miller's recent "Otolaryngology," indicating a characteristic stroma of edematous tissue with prominent vascular changes. Similarly, Morrison and Eggston and Wolf found these growths to be characteristically of a traumatic or inflammatory nature with frequent thrombosis of blood vessels, which has given rise to the diagnosis often given by pathologists of "angiomatous polyp." Dr. LeJeune agreed that these are benign growths but would prefer to retain the designation of "polyp" as a challenge to pinpoint our diagnosis.

The disparity between clinical and histologic diagnosis in the 81 cases cited by Dr. Salinger is not entirely the fault of the pathologist, but should be attributed to the lack of unanimity of thought between the pathologist and the laryngologist.

Dr. James M. Robb recalled having read a paper in which he termed the controversial growth mentioned by Dr. Salinger a "hemorrhoid of the vocal cord." He was impelled to so designate it because of the report of the pathologist, who said, "In my opinion frequently there is a dilated vessel, a dilated blood vessel, that in time undergoes changes; chronic irritation always produces fibrous tissue which always contracts." Dr. Robb would be very glad to find some other label to attach to this condition, but because it seemed to be mainly a varix he thought "hemorrhoid" was not too bad.

Dr. Salinger was glad to have the references mentioned by Dr. LeJeune, in which the authors seemed to agree on a typical microscopic picture. However, from his own experience he is not convinced. The fact that the pathologist in examining a polyp rarely calls it a "polyp" indicates the lack of uniformity in the histologic analysis. Until pathologists can agree on a characteristic histologic picture peculiar to the polyp, he is unwilling to employ that term and would prefer naming it simply " a benign growth of the vocal cord."

**Primary Malignant Tumors of the Uvula.**

Dr. Fred Z. Havens and Dr. Rich C. Ye.

Primary malignancy of the uvula is very rare. Havens and Ye were able to collect only seven cases that were observed at the Mayo Clinic from 1919 to 1952. During this period there were some 1,500,000 patients admitted to the Clinic. In 42.8% of the cases secondary lesions were present which led to disaster. The lesion is usually an ulcer or a granulated area on the uvula which appears indurated and stiff rather than flabby, as is the normal uvula. The authors advise removing the organ by surgical diathermy. Neck resection was not carried out in cases where there was no evidence of lymph node involvement.

Only two of the cases survived, one for four years and the other for one year when last heard from.

### Discussion

Dr. Leroy Schall, reviewing his records of 22 cases seen since 1935, finds himself in agreement with the essayists. He is impressed by the absence of early symptoms in some of these cases. In one instance it was discovered by the patient's dentist. Unfortunately many of these patients come in too late and it is difficult to determine whether the lesion was primary in the palate or in the uvula. Eight cases were treated by electrosurgical removal; six showed no recurrence for periods of 1, 2, 6, 7, 8, and 10 years. Four cases were treated by irradiation. Three showed no recurrence after three, four, and six years, respectively.

Dr. James M. Robb inquired whether Dr. Havens removed the soft palate. He noted that one patient was dead but was wondering whether the others have been followed up to date. Certainly a malignant lesion of the soft palate is a serious problem.

Dr. Havens said that, like Dr. Schall, he was unable in many cases, judging by the records, to determine just where the lesion started. Therefore, he omitted these cases from his series. It was his desire to point out the danger of this lesion even when it was localized to the palate alone. Thus, future investigators could be guided in their evaluation of the lesion by the knowledge that this series included only those cases in which it was positively demonstrated that they were primary in the uvula.

Too much emphasis cannot be placed on the importance of careful examination. One case cited had passed through the hands of a very competent otolaryngologist, who was very much embarrassed at having missed the lesion. In this case it involved only the very tip of the uvula but on palpation seemed to be firm enough to excite suspicion.

In reply to Dr. Robb's question, the answer would be to take off as much tissue as necessary, even if it meant removing the entire palate.

In the one case which was operated on the lesion involved only a third of the uvula. All the others were years back.

**Use of the Larynx in Repair of Cicatricial Stenosis of Esophageal Introitus.** DR. JOHN B. ERICH.

Dr. Erich reported a case in which the larynx was attached to the esophagus to bypass a stricture at the introitus resulting from radiation necrosis following therapy for a carcinoma. The patient was a man of 68. The lesion, a large malignant tumor, Grade 3, occupied the larynx and hypopharynx, causing marked obstruction. Also there was an enlarged cervical node.

After tracheotomy the growth was destroyed by surgical diathermy, following which radon seeds were implanted at the site of operation as well as into the lymph node. Feeding was accomplished through a tube. Marked edema and perichondritis with sequestration ensued. Eighteen months later there was no evidence of recurrence.

It was found that the vocal cords were in complete abduction, which was favorable for the technique which followed. The larynx was split and severed from the trachea, which was dissected free from the esophagus for a distance of 3 cm., and its free margin then sewed to the skin. The esophagus was severed just below the stricture and attached to the mucosa of the larynx, which then served as its upper end. Since the cords were well abducted, soft food passed rapidly, and within a short time the patient was able to swallow any type of well-masticated food. Three years have elapsed and the condition is satisfactory, with no indication of any recurrence.

**Mechanical Appliance for Cicatricial Stenosis of Larynx and Upper Part of Trachea: Report of a Case.** DR. JOHN B. ERICH.

Stenosis of the larynx due to perichondritis following an automobile accident in a man of 26 was treated by excising of the scar tissue through a thyrotomy and the implanting of a Thiersch graft over a sponge. After the graft had taken, an acrylic obturator was prepared and worn by the patient. At the time of operation it was noted that the esophageal wall protruded into the lumen of the larynx due to loss of a great portion of the cricoid cartilage. A small fistula developed, which failed to heal despite closure with a flap of mucous membrane. It was then necessary to cover the area with skin which was implanted via a tube flap obtained from the clavicular area and brought up into the larynx. The fistula was thus closed, but the redundancy of the skin flap so narrowed the lumen as to prevent adequate breathing. Consequently, an acrylic tube was fashioned with a ring-shaped extension protruding through the tracheostomy, through which the tracheal cannula could be inserted. A hole in the tip of the cannula permitted air to pass from the trachea into the upper air passages so that breathing through the nose and mouth could be accomplished when the external orifice of the cannula was corked. The cannula and acrylic device could be easily removed for cleansing and has been worn with satisfaction for two years up to date.

(No discussion.)

# Books

**An Atlas of Otolaryngic Pathology.** By Col. J. E. Ash, R.A., M.D., and Muriel Raum, M.D. Price, not given. Pp. 572. The American Academy of Ophthalmology and Otolaryngology; The American Registry of Pathology; The Armed Forces Institute of Pathology, 1956.

This Atlas is a classic contribution to the field of otolaryngology and should be within reach of every practicing otolaryngologist. It covers in a very practical manner all the pathology which is encountered in office and hospital practice. The hundreds of photographs throughout the book make it easy for a practicing otolaryngologist to establish or confirm a diagnosis of conditions he encounters in his office. The book is divided into sections. The first describes the general pathological conditions, such as inflammations, tumors, dermatoses, fungus diseases, tropical diseases, effects of ionizing radations, etc. The second chapter gives a comprehensive description of the pathology of the upper respiratory tract, including the commonly found pathological conditions in the nose and throat, and the tumors in bone and in the pharynx. The next chapter describes pathology in the lower respiratory tract and includes the mediastinum and thymus. There is also a chapter on pathology of the neck and an excellent one on the ear. Otosclerosis, deafness, and Ménière's disease are extremely well presented. This Atlas is an outstanding contribution to our specialty and should be widely used.

**Proceedings of the Fifth International Congress of Oto-Rhino-Laryngology, Amsterdam, 1953.** Edited by P. G. Gerlings and W. H. Struben. Price, H. Fl. 65. Pp. 940, with numerous illustrations. Van Gorcum & Co., Assan, Netherlands, 1955.

This book is a compilation of the papers and discussions presented at the Fifth International Congress of Oto-Rhino-Laryngology, held in Amsterdam.

The first section deals with three main subjects: tumors of the bronchus, audiology, and allergy.

The second section deals with a presentation of numerous papers, approximately 150, in every field of otorhinolaryngology and many related subjects. These papers are not only presented in great detail but are supplemented with numerous photographs to illustrate the subject matter. This compilation is almost encyclopedic in character and definitely represents not only the present-day evaluation of the problems in this field but also the most recent medical and surgical advances. Each article further contains a series of discussions by those in attendance, helping to evaluate the problems presented by the authors.

This is an extremely valuable book and should be included in the library of every otolaryngologist.

# Directory of Otolaryngological Societies *

## FOREIGN AND INTERNATIONAL

### Canadian Otolaryngological Society

(Société Canadienne d'Otolaryngologie)

President: Dr. G. M. T. Hazen, 208 Canada Building, Saskatoon, Sask.
Secretary: Dr. G. A. Henry, 328 Medical Arts Building, Toronto.
Place: Banff Springs Hotel. Time: June 17-19, 1957.

### International Bronchoesophagological Society

President: Dr. Theodor Hünermann, Düsseldorf.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Sixth International Congress of Bronchoesophagology.
Place: Philadelphia. Time: May 12-13, 1957.

### International Congress of Audiology

Place: Leyden, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Netherlands.

### International Course in Paedo-Audiology

Place: Groningen, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Netherlands.

### Pan-American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

President: Dr. José Gros, Havana, Cuba.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Sixth Pan-American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Place: Brazil. Time: 1958.

### Sixth International Congress of Otolaryngology

President: Dr. Arthur W. Proetz, 3720 Washington Blvd., St. Louis.
General Secretary: Dr. Paul H. Holinger, 700 N. Michigan Ave., Chicago 11.
Place: Hotel Statler, Washington, D. C. Time: May 5-10, 1957.

## NATIONAL

### American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. John R. Lindsay, Chicago.
Secretary: Dr. Hugh A. Kuhn, 112 Rimbach St., Hammond, Ind.

### American Academy of Ophthalmology and Otolaryngology

President: Dr. Algernon B. Reese, 73 E. 71st St., New York 21.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave., Bldg., Rochester, Minn.

### American Board of Otolaryngology

President: Dr. Frederick T. Hill, Professional Building, Waterville, Maine.
Secretary-Treasurer: Dr. Dean M. Lierle, University Hospitals, Iowa City.

### American Broncho-Esophagological Association

President: Dr. Clarence W. Engler, 2323 Prospect Ave., Cleveland.
Secretary: Dr. F. Johnson Putney, 1719 Rittenhouse Sq., Philadelphia 3.
Place: Mark Hopkins Hotel, San Francisco. Time: May 21-23, 1958 (afternoons only).

### American Laryngological Association

President: Dr. LeRoy A. Schall, 243 Charles St., Boston 14.
Secretary: Dr. Harry P. Schenck, 326 S. 19th St., Philadelphia 3.
Place: Statler Hotel, Washington, D. C. Time: May 3, 1957.

### American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Percy E. Ireland, 100 College St., Toronto, Canada.
Secretary: Dr. C. Stewart Nash, 700 Medical Arts Bldg., Rochester 7, N. Y.
Place: Mark Hopkins Hotel, San Francisco. Time: May 21-23, 1958.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

**SECTIONS:**

Eastern.—Chairman: Dr. Joseph Sullivan, Toronto, Canada.
Place: Royal York Hotel, Toronto, Canada. Time: Jan. 31-Feb. 1, 1957.
Southern.—Chairman: Dr. Mercer G. Lynch, New Orleans.
Place: Roosevelt Hotel, New Orleans. Time: Jan. 16-17, 1957.
Middle.—Chairman: Dr. Paul M. Moore, Cleveland.
Place: Hotel Cleveland, Cleveland. Time: Jan. 9-10, 1957.
Western.—Chairman: Dr. Sigurd v. Christierson, San Francisco.
Place: Hotel St. Francis, San Francisco. Time: Jan. 19-20, 1957.

AMERICAN OTOLOGICAL SOCIETY, INC.

President: Dr. John R. Lindsay, 950 E. 59th St., Chicago 37.
Secretary-Treasurer: Dr. Dean M. Lierle, State University of Iowa, Iowa City.
Place: Statler Hotel, Washington, D. C. Time: May 4, 1957.

AMERICAN OTORHINOLOGIC SOCIETY FOR THE ADVANCEMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY, INC.

President: Dr. Joseph Gilbert.
Secretary: Dr. Louis Joel Feit, 66 Park Ave., New York 16.

AMERICAN SOCIETY OF OPHTHALMOLOGIC AND OTOLARYNGOLOGIC ALLERGY

President: Dr. Dean McAllister Lierle, University Hospital, Iowa City.
Secretary-Treasurer: Dr. Michael H. Barone, 468 Delaware Ave., Buffalo 2.
Place: Palmer House, Chicago.

SOCIETY OF MILITARY OTOLARYNGOLOGISTS

President: Col. Wendell A. Weller.
Secretary-Treasurer: Major Stanley H. Bear, M. C., 3810th USAF Hospital, Maxwell AFB, Ala.

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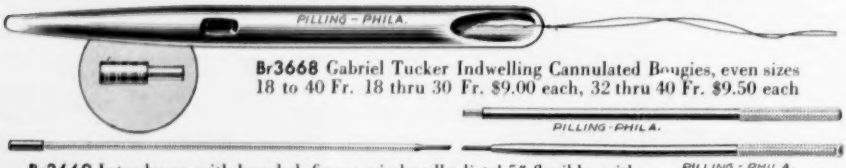


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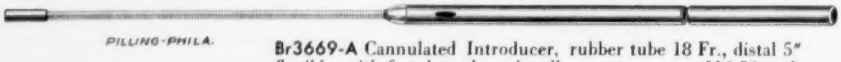


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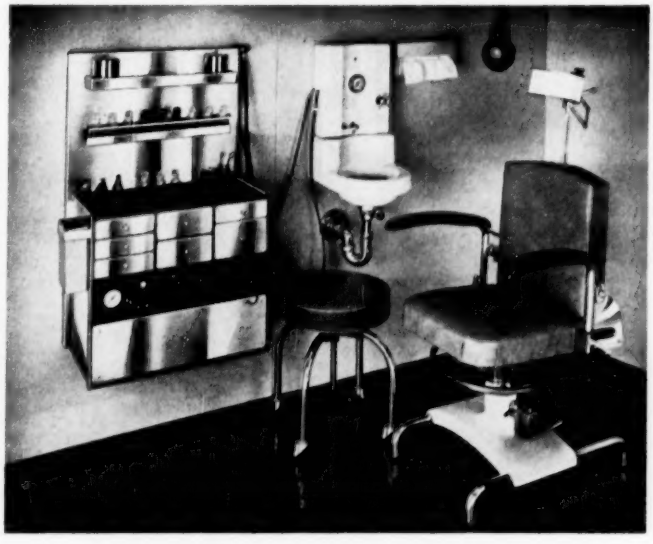

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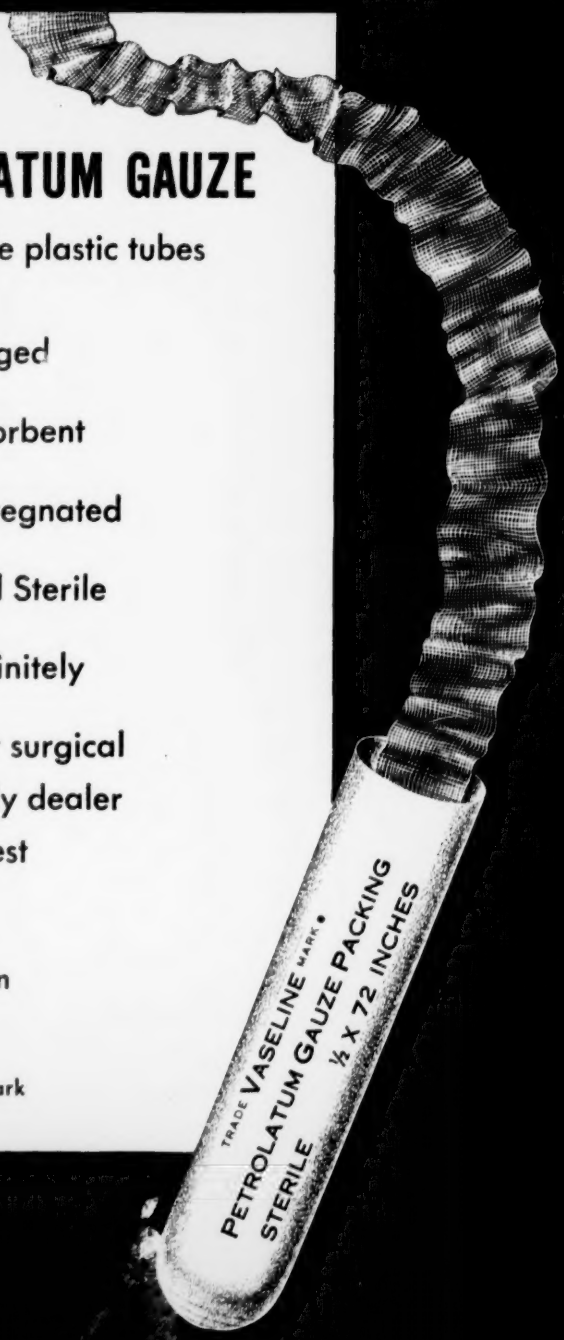
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